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Volume 1 April 1955

P R O C E E D I N G S
OF THE
FIFTH ANNUAL INSTITUTE
ON
INDUSTRIAL ENGINEERING
SPONSORED BY
American Institute of Industrial Engr., Inc.
145 North High Street, Columbus, Ohio

AMERICAN INSTITUTE OF INDUSTRIAL ENGINEERS, INC.

FIFTH ANNUAL

CONFERENCE AND CONVENTION

HELD AT

Flag Auditorium, Kentucky Hotel, Louisville, Kentucky

May 5, 6, 7 and 8, 1954

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FOREWORD

The 5th Annual Convention of A.I.I.E. in Louisville, Kentucky during May 1954 was the first convention of A.I.I.E. outside of the State of Ohio. It was the first such convention of a National Engineers' Society in the State of Kentucky. The Louisville Chapter of A.I.I.E. is proud to have had a part in making these "firsts" realities. Our pride has prompted another "first" --- these Proceedings. These are the first proceedings published for a convention of A.I.I.E. We had the first student counciling service and the first employment service offered at a convention. We had the first exhibits of industrial products offered at an A.I.I.E. convention.

The Louisville Chapter (Host Chapter) of the A.I.I.E. feel that this conference and convention offered a rare opportunity to exchange ideas with the top men in our field and truly promoted the advancement of the individual and the industrial engineering profession.

We dedicate these Proceedings to the various Local Chapters of A.I.I.E. who have the courage to ask for the honor of entertaining the National Convention. These Proceedings are not presented as a standard not a model for those that follow. They are presented, rather, as the FIRST STEP towards what we hope will be an eternal continuity of successive betterment.

Members (Host Chapter)
Louisville, Kentucky

March 10, 1955

PROCEEDINGS DATA COMPILED BY

Thomas C. Potter John Guenthner Horace L. Pearce (*)

Stephen Arthur Derry (*)

(*) Not member of ORIGINAL Proceedings Committee

PROCEEDINGS CHRONOLOGY

February 1, 1954:

Mr. Potter was appointed by the Host Chapter Convention Chairman (Mr. Roy B. Davis) to serve as Proceedings Committee Chairman.

December 27, 1954:

Mr. Guenthner was appointed by the Host Chapter President (Mr. Dean Sorensen) to serve as proceedings Committee Co-Chairman.

January 26, 1955:

Mr. Pearce was appointed by action of the Host Chapter Board of Directors to succeed Mr. Potter and Mr. Guenthner as Proceedings Chairman.

February 28, 1955:

Mr. Derry was appointed by action of the Host Chapter Board of Directors to assemble, arrange and complete material for publication. Also to direct the actual preparation of material for publication, and publish proceedings at earliest date possible.

March 10, 1955:

Contract was let for the publication of the Proceedings by The Ditto-Hayes Advertising Service, Starks Building, Louisville, Kentucky. (The lack of sufficient funds forced action that every corner be cut to publish proceedings within budgets limits).

April 8, 1955:

Contract was let for the binding of the Proceedings by Roderer Book Bindery, 117 North 4th Street, Louisville, Kentucky.

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(Conference Theme)

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FIRST SESSION: Wednesday, May 5, 1954, 9:00 A.M.

Theme: "NEW CONCEPTS OF OLD PRACTICES"

Presiding Officer: Mr. O. H. Tashjian, Chief Industrial Engineer
Reynolds Metals Co., Richmond, Virginia

MR. TASHJIAN: Gentlemen: -- It is certainly a pleasure to be here at your opening session this morning. The three speakers are going to bring us up to date on some of the problems that I am sure we have all encountered. I would like to present Dr. Raymond Villers(*) now, who will cover the subject of "NEW CONCEPTS IN DECENTRALIZATION" -- Dr. Villers.

DR. VILLERS(*): Thank you very much Mr. Tashjian. We try to define decentralization, which is a word that has been widely used, and I think we can say simply that decentralization is an approach to the problem of organization. Right now it falls upon us the burden of defining what we mean by organization. I think we can say that organizing can be defined as a method of integrating the efforts of a group of men toward a common goal, the men that compose a group and a common goal are what characterize an organization and make an organization something different from merely a meeting of men together. The common goal may be fighting, as in the case of the armed forces, or it may be administering the community life, as in the case of a state or town organization. Or it may be producing as in the case of our industrial organizations. But whatever the goal of the organization, the problem of integrating the efforts of the men who are part of the organization, is always to find a balance between the individual and the common goal. The individuals must cooperate and coordinate their activity towards the common goal under a certain leadership, and the common goal cannot be canceled out or otherwise ignoring the rights, the aspirations, and the weakness of the individuals who are part of the group. So integration of effort of a group of men towards a given goal always requires some balance between the rights of the individual and the goal of the group. This balance is sometimes acquired at the cost of sacrifying completely the individual, as in the case of what could be called, a very centralized organization where everything comes from the top, and where the individual just obeys orders, so as to serve the common goal, and the rights and the aspirations of the individuals are more or less ignored. However, it should be noted at this time that a "completely" centralized organization just does not exist, because even in the case of slavery and dictatorship, the individual has always a slight chance to revolt, even in a concentration camp - the individual has some sort of freedom of movement, although it is constantly restricted, but it can be almost completely centralized in the case of slavery or dictatorship. But men don't act as robots, and it is because man never acts as robots that it can be said, it seems to me, that even in the automatic factory, which we are told is in the making, or is already made partly, these will not be a completely centralized organization, because there will always be some room for individual freedom and individual mistakes. There will always be a human element involved in running the automatic factory, if only because of terrific maintenance problems which will probably be worse than all the maintenance problems with which all of you are familiar, and which sometimes are pretty rough. The electronic machines of the future are going to require a lot of maintenance, and we all know that maintenance men do not always abide by standard practices that the engineers have painfully determined. You will know more about standard practices in about half an hour from now when you listen to Professor Lesser, but in the meantime I think you will agree with me that the "Don'ts" are not always observed, and that there is a need for some sort of flexibility, and that means that a completely centralized organization just does not exist.

(*) Partner, Rautenstrauch and Villers, Consultants to Manufacturing Industries, 125 Broad St., New York 4, N. Y.

A completely decentralized organization does not exist either, otherwise it would not be an organization, it would be a loose grouping of men trying to work together but not accomplishing anything or not serving a common purpose. So in many organizations, we find some sort of centralization, and some sort of decentralization. An organization is more or less centralized, more or less decentralized. In recent time the emphasis has been in industry on decentralization - Why? -

There are many reasons, among which I think we can segregate two main reasons why the problem of decentralization is so actual today. The First - is the growing size of the industrial enterprises. The fact that today a large corporation may group somehow half a million men employed by the company, and this is an actual figure, and not a single case. So that the size of the corporations themselves, make it impractical to run them on a centralized basis. The last example of an almost completely centralized organization was the Ford Motor Company, at the time Henry Ford Senior died and that was ruining the company. If he had lived a few more years the company would literally have died. So the size of the company makes it difficult to centralize the operation and that is why discentralization is very much in the air and this is true, for even what we call the small business. The small business today, the small industrial enterprise groups easily a hundred or a hundred and fifty men, and we can say that is very small, but still it is not possible for one man to lead 150 men on a completely centralized basis, especially because of the growing complexity of the various activities of these men. These 150 men in the small enterprise don't all do the same thing. One is a purchasing agent, but the other one may be a mechanical engineer, and the other one may be a maintenance worker, and all of these people have various tasks and it is practically impossible for one man to give instructions to such a diversified group, even if the group is small. So the first reason why decentralization is very much in the air is certainly the growing size and the growing complexity of modern industry.

There is another reason too, that should be mentioned - It is the growing recognition of the human factor involved. This has been going on for quite a few years, and especially since the end of World War II. A considerable amount of work has been done, research work, in colleges and in industry concerning the reaction of the human being to the industrial life, and to the conditions of life in industry, and it has been found that a great amount of unfortunate situations has been created by modern industry putting men, and not only men on the bench who work at machines for 8 hours a day pressing the button of a punching press, but also men at the various levels of supervision and management in a position where they more or less spend their time, giving orders, but giving orders that they have not initiated themselves; they have just received them and they transmitted them, and very often junior executives find themselves in the position of telling their subordinates, what they had been told they should tell them. They learn by and by that the way to success is to know how to "pass the buck," in case of difficulty, avoid problems, avoid trouble - I see a few smiles so I think you seem to know what I am talking about. This condition is unfortunate because the greatness of our country has been made by the pioneering spirit, the spirit of men who took responsibility and had the authority of taking responsibility, and were not afraid to step forward. Many of our young college graduates have this spirit, but after they have spent 15 or 20 years in a department, obeying orders, they don't have this spirit anymore, and it is not by accident that of the executives of today, who belong to the older generation, almost all of them complain about the difficulty of finding successors, men who have the "guts" to stand for something and who will speak-up their mind. Well, it is because in many of our organizations, they have been told that if they speak-up their minds too freely, they are not going to be promoted, and they might not even be kept. Now this is a situation that gives some cause for worry, and a situation which has been recognized as being due largely to an excessive centralization, and this excessive centralization comes from the fact that up to now, decentralization has not been completely mastered. Why?

Well, because decentralization in industry is not a simple matter. Decentralization raises problems in organization of a highly technical nature, which does not prevent the organization of decentralization of modern industry, but makes it a problem that deserves full attention, and I want to tell you briefly about this technical problem of organizing decentralization.

To fully appreciate the nature of the problem, let us consider a conventional organization chart. It is a useful representation of the assignments received by the various executives. It also shows at what levels they are in the whole organization. But it does not disclose anything about the complex interplay of interfunctional relationships. Any attempt made to represent graphically this complex interplay of relationships clearly shows that it cannot be done. Let's take the case of an operating unit, which is a so-called decentralized division of a large corporation, or a middle-sized company which includes 100 or 200, 1000 men, or maybe 60,000 men, in a unit of a large corporation. Primarily, at the base of the organization we have a certain number of men working on machines, using tools to operate on some material, according to certain specifications. These five elements we could call them, the five fundamental elements of the operating unit. Whatever you make, you always have men working at a machine using certain tools and working on some material, according to some sort of specifications. At the very top you have the Head of the Organization - Which you can call the President or the General Manager. Supervising these men you have the Plant Management - The Production people - The Plant Superintendent, The Foreman, the assistants, and this is a simple picture, this is the old time picture - In modern industry, the picture is vastly complicated by the fact that the Plant Superintendent could not operate his men, if he did not have here an engineering department to produce the specifications that are being used here, and this specifications creates a certain relationship between the fundamental unit and the engineering department. This Plant Manager or his assistants cannot go and get the material; you have a purchasing department that does that, and that ends the relationship here, but the material cannot be bought without asking the engineering department what they think of the quality of the material, so you have another relationship there, and another one here. These men have been hired by a personnel department, they are paid by a pay-roll department; when they come late, the plant manager is not entirely their boss because he cannot say to the man, "Well, I know why you are late, I know what has happened, but do a good job now," no, the man punches a time-clock card, and he is paid by the payroll department, and this is the way it has to be, because the organization is too large to take care of all the individual circumstances. There you have a research department, a research department that has to take into account the skill of the men what they really want, the kind of material they use, the kind of tools we are going to design, and I could go on like this for hours, but I wanted to show simply the infinite complexity of these inter-functional relationships, and the organization charts which we are used to, and which are very useful, don't even begin to show this complexity, so that when we reach the plant, we are surprised by the complexity of the relationships, and a bit shocked by it. There have been many books published in the last few years which have tried to find solutions to the problem by trying to ignore this complexity, and to make life in industry - simple. Well, this is a matter of opinion, but it seems to me that we should not ignore this complexity, we should live with it, get used to it and handle it. At this very minute, this room is full of the music made by an orchestra that is playing at Los Angeles, and there is also a speech that is probably being made at this time in Washington, and there are many other things that go through this room in the form of radio waves, and this complexity does not botherus because we have learned to master it by using radio receivers or television receiver sets, and generally, the more we progress in science, the more we realize the complexity of the fields we are studying. The Universe was very simple when Newton told us how it was built, but now we know it is not built that way, and we begin to understand that we don't understand very much about the Universe, but that certainly, it is

extremely complex. I think complexity should not frighten us, and especially should not frighten engineers. What we have to do, is to live with it, and not try to make it simple, because this is simply a refusal to face the facts of life. I think that the sooner we accept the fact that industrial life is very complex, the sooner we will be able to progress on the road to a happy organization. A happy organization, which means one - that we will establish a reasonable balance between the rights of the individual and the duties of the organization. The attempts to decentralize have been made for quite a few years on a geographical basis. One decentralizes a plant. Large organizations instead of having a half a million employees grouped in one town, which would not be feasible, have decentralized them, and decentralized into a division in an operating unit, which by every standard of measurements are large organizations, including many thousands of employees, and the same problem exists in what we call the small or middle sized business with only a few hundred employees, all these organizations have been decentralized on a geographical basis, but this is not enough, if we want to take full account of the complexity of the organization, we should go one step further on the road toward decentralization, if we want to create conditions where men can again be themselves, and that step further is the functional decentralization.

In the concept of functional decentralization, each function is decentralized. The engineering department is a decentralized unit, the purchasing department is a decentralized unit. The personnel department acts independently. The difficult thing is that if they act independently, they run the risk of failing to co-ordinate their efforts, and then you will have here a great confusion. It is like if all radio emissions were made on the same wave length, at the same time with the same strength, we could not use any of them. The problem is to regulate this complex situation and to organize the decentralization. This is currently being done in a substantial and very rapidly growing number of organizations, and it is being done in the form of centralization of planning and control. It consists in adding to the traditional functions to which we are accustomed once more, "planning and control" exclusively in charge of coordinating all the activities, regulating the timing of the radio wave, if you want to pursue the analogy, and organizing the coordination of these units, these functions that are left independent and decentralized under the general leadership of the top management people. It means translating the top management policy as indicated to planning and control in terms of instructions that can be understood in their own language, by such diversified functions as purchasing, engineering, personnel, etc. This means the careful organization of planning, translating these top management decisions into terms that are definite assignments. Planning and control should translate these into terms of what tools the tool department are going to produce, what kind of designs are going to be made. This requires a full understanding of the value of decentralization in the plant. Now it could be done in the form of centralization - in a highly centralized organization, the planning and control department would tell all these functions what to do, when to do it, and how to do it. In a decentralized organization, on the contrary, the planning and control department, should still tell everyone what to do, and when to do it, but should not tell them how to do it, and should also ask them whether they can do it or not. It is then a two-way communication.

This is the concept of decentralization of authority and responsibility, together with centralization of planning and control.

Now men being what they are, you cannot rest the future of an organization on the possibility that one of them would fail, and that's why a tight control is necessary. A tight control does not need to mean oppressive management. It means simply that after planning has been decided, everyone should report whether he has been able to keep up with the schedule or not. In that concept of decentralization, the control department which is the same as the planning department, simply records the statements

that things have been done according to schedule, or have not. If they have not, some top management decision is necessary. This concept is extending to all activities of the organization, including financial activity, purchasing activity, production activities, research, maintenance, etc. It is a concept which appears as the best approach to the problem of finding an equilibrium between the rights of the individuals and the goal of the modern industrial organization. This concept is gaining recognition very rapidly throughout the country. For years we have heard a lot about centralization or decentralization. It is to be expected that in the coming years we will hear more and more about centralization of planning and control associated with decentralization of authority and responsibility.

MR. TASHJIAN: Thank you Dr. Villers. The next topic is "SOME INSIGHTS INTO STANDARD PRACTICES" presented by Professor Arthur Lesser, Jr.(*).

PROFESSOR LESSER (*): I believe that it is safe to say that there would be no conference this week in Louisville addressed to the theme of "What's New In Industrial Engineering" had there been a strict devotion to standard practices. On the other hand, industrial engineering probably would not be where it is today without standard practices. Thus standard practices are a two-edged sword. They can expedite progress in the sense of helping to attain objectives, or they can inhibit progress.

The purpose of this paper is to examine the nature of standard practices including their objectives and significance together with the role new concepts play in them. The scope of this paper is to provide some basic thoughts for further research and analysis on this complex subject.

So that we shall understand each other, I am going to describe standard practices as those procedures or rules of conduct which have been set out in some detail in descriptive form and which have been generally accepted among those versed in the field. They are not standards for attainment, such as standard times.

Standard practices are in effect similar to the formulas developed in the physical sciences. On a conceptual level, standard practices are models based on certain assumptions, unfortunately usually unstated. They are adopted because they presumably furnish a tried and tested path to attain certain objectives. Thus if a firm is having difficulties with its employees because of a haphazard wage system, an evident remedy would be to adopt such a standard practice as a job description and evaluation system.

Many standard practices are adopted with great hopes of attaining successful results, but often the hoped-for objectives are not reached. Then the disappointed users will probably assert that this type of standard practice does not accomplish what its protagonists claim for it. By protagonists, I do not mean the person who is trying to sell his own brand of standard practice in order to earn a fee, but rather those who are convinced on the basis of principle that the standard practice in question will give the desired results. In order to determine why there are frustrated users of standard practices -- other than being oversold -- it will be necessary to take a closer look at their nature.

The term standard practices covers a broad spectrum and the knowledge that there is a broad spectrum is important when trying to look for results. My intention is to describe the spectrum in terms of result predictability. At one end of the spectrum are those practices where the results can be predicted with high accuracy and precision, engineering standard practices. At the other end are those where the accuracy

(*) Humphreys Professor and Head, Industrial Engineering Department, Stevens Institute of Technology, Hoboken, New Jersey.

and precision are relatively low. Generally speaking practices with high result predictability treat with material objects. In dealing with material objects, it is possible to create a reasonably stable and controllable cause system. As long as we operate within the boundaries of this system, the probability of high accuracy and precision will be great. As an example, the practice of using infra-red rays for drying the finish on automobiles demands certain limited types of fast drying finishes, and carefully controlled conditions, in order to meet specifications. Thus we might say that in order to design a successful practice, using material objects, the nature of the physical system must be thoroughly understood and the practice must be developed with the limitations of this system strictly adhered to. Contrast this situation with practices where the human element is a factor.

Unlike selected areas in the physical world, human nature is poorly understood. Furthermore a man has considerably greater difficulty in dealing with other humans than with objects. His emotions and preconceived ideas constantly get in his way and, I might add, that physical scientists are no exception to this rule. Thus we find that trying to establish a practice within the bounds of predictable human behavior is very difficult. Humans provide an unstable system of causes and because of this results in general can be predicted with a relatively low order of accuracy and precision. Realizing the difficulty of attaining predictable results in systems involving humans, engineers have sought means of establishing stable systems borrowing their ideas from the physical world. The works of Frederick Winslow Taylor[1] give an excellent example of this methodology.

Taylor was most disturbed by the results obtained in simply assigning jobs to workers and letting them do the jobs each in his own way. Taylor felt there should be a "one best way," of doing a job and it was management's task to find that one best way, literally by picking the brains of the workers and then improving upon their ideas. Once this one best way was determined, Taylor established it as a standard practice and demanded 100% compliance in carrying it out. By this means he planned to remove the customary wide variability due to method. By careful selection and training of workers in the one best way, he endeavored to cut down greatly the variability due to different workers. Taylor wanted only a "first class man", as he understood him, to work for him. By an exhaustive study of the job in order to determine what comprised a fair day's work, he aimed to set an incentive rate, his differential piece rate, which he felt would stimulate the worker to exert his best effort continuously and penalize him if he did not use his best effort. Thus, he hoped to cut down the variability due to changes in effort. In short, by reducing the variability of the important factors entering into doing a job, Taylor endeavored to create a stable system from an inherently unstable one. However, Taylor's rigid model was not acceptable in a free society and Hoxie[2], in 1915 informs us that it was only barely approximated in practice both from the standpoints of labor and management. The key to the failure of Taylor's model to work satisfactorily was its lack of acceptability. Taylor himself admitted that acceptability was one of his greatest obstacles.

However, efforts continued to create stable cause systems involving humans. One of these is the well-known machine paced assembly line. Significant variables, such as job method and selection and training of workers, are carefully controlled but with more latitude than prescribed by Taylor. As long as a worker can keep up with the

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1. Taylor, Frederick Winslow, Scientific Management, Harper and Bros., New York, 1947 (Reprint)

2. Hoxie, Robert Franklin, Scientific Management and Labor, D. Appletin & Co., New York, 1918.

line, there is generally no effort to force him to do his job in a certain stipulated way. Furthermore, the pace of the line is not determined exclusively by management through exhaustive time study, any more than the standard time for a job is set unilaterally. The pace of the line and specified time for a job are a matter for collective bargaining as is so well pointed out by Abruzzi.[3] In the former, the group bargains with management on the pace, and in the latter, the worker bargains with the time study man. The workers have their own ideas of equity in the setting of piece rates which are likely to be at variance with those of management.

As a practical matter, acceptability must come before predictability, which fact Taylor was unwilling to recognize. It is only in the conceptual world that accurate and precise predictions can be made in systems involving humans. In real life, predictions based on assumptions must be modified to be in accord with the real situation. It is only after acceptability is reached that results can be reliably predicted. It is not the scope of this paper to consider the questions of making correct predictions of acceptability in probabilistic terms and of the fact that there are varying degrees of acceptability including absolute, partial and conditional. The question of acceptability is an intriguing one and deserves further thought.

It is interesting to note in passing that the engineer will cheerfully accept the limitations put upon him by nature but he has a tendency to dislike, or to prefer to ignore, the limitations put upon his work by other humans. The tendency is for the engineer to take the position that his answer, being based in his eyes on objective facts, is correct and it is only the perversity of the workers that causes compromise. He fails to appreciate that his solutions are generally judgments based on a value system different from that of the workers. His sense of frustration is even worse if he believes that what he is doing is branded as being scientific. "One simply cannot quarrel with scientific findings." This is particularly true in the case of setting time standards. However, the introduction of statistical concepts has brought a revolution in this thinking. Using statistical tools, Abruzzi[4] has pointed out that the standard practices used in classical time study are not scientific and hence cannot be depended upon to provide results which are sufficiently accurate and precise for predictive purposes. I think it is safe to say that this is one of the chief obstacles that stood in the way of the adoption of standard time study data at a meeting held in New York City in January 1953 under the auspices of the American Standards Association. (A.S.A.-XX1705)

Returning to the idea of attaining a stable cause system by controlling significant variables, it would seem to follow that since humans in general introduce the greatest cause of variation, their elimination would go far towards the establishment of a constant cause system in a statistical sense. This is done by means of the new concept of the automatic factory which is gaining greater acceptability. In the fully developed automatic factory, humans are withdrawn completely from the production process and fill an overseeing and maintenance role. At this point I wish to draw a number of general conclusions from the preceding discussion:

1. In order to obtain high predictability in results, it has been the customary practice to impose some sort of arbitrary system, with little latitude in human terms, upon those who are involved. This may have its own cost in terms of boredom, lack of interest in the job and low morale which have so frequently been cited in

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3. Abruzzi, Adam, Work Measurement - New Principles and Procedures, Columbia University Press, New York, 1952.

4. Ibid.

connection with assembly line operations. 2. The details of standard practices will differ from application to application because of different variables and differing weights to be placed on these variables in different environments. 3. In real life terms a standard practice must be considered acceptable by those involved before accurate forecasts of results can be made. 4. As the greatest variability is introduced by humans, their elimination will per se be a substantial factor in developing a stable cause system with high result predictability, which is the case in the automatic factory.

The task of controlling significant variables particularly in situations involving humans often is a formidable one. In the first place, there are both internal and external factors, which must be considered and controlled if the practice is to attain its objective. Internal factors are those which presumably management can manipulate in the interest of getting stipulated results. External factors are those over which management may have little or no control powers. Superficially, it would appear that control of internal factors is simple. Consider, however, the fact that changes are continually being made within the plant in terms of products, materials, people, machines and methods. Any of these changes can have important effects on significant variables. I am thinking, for instance, of a large aircraft manufacturing plant mentioned by Kerr and Fisher,[5] that had adopted a job evaluation plan in which skill was weighted fifty percent. As this company changed over during the war from practically a handicraft basis to mass production, the skill element in the jobs became considerably smaller, due to work simplification. Thus the job evaluation plan became difficult to administer because of this chance in a significant variable. As another example, time study men are familiar with the fact that standards tend to become looser over a period of time. These may develop through greater proficiency, individually devised short-cuts and small technological changes which appear insignificant when they are made. The effect can be a situation where the incentive system actually may hold back production. Business Week of April 24, 1954, reports that the workers at Willys Motors voted to abandon the wage incentive plan, which they had for several years, and thereby receive 5% less pay. The article goes on to say, "Within a week after the dropping of the old incentive system, Gosser reported the plant was turning out 5% more cars with 74 fewer workers." Apparently the practice had become obsolete, as I shall discuss later.

The control of external factors is even more difficult, if at all possible to control. In one furniture firm that I am familiar with, the furniture is manufactured on a production line basis. Each man is a specialist in building backs or arms for chairs or sofas. As long as the company remains in full production because of sufficient market demand, this set-up of relatively minute job-breakdown was adequate. However, as soon as the demand for the company's product declined, it became necessary to switch people from their specialty to another job at which they could not make their rate because of unfamiliarity with it. Both the company and union recognized the fact that they were having considerable morale trouble but apparently it was not evident to them that their practice of minute job-breakdown was no longer feasible under changed external conditions. In the previously cited paper by Kerr and Fisher they call attention to the great pressure put upon job evaluation plans by external changes in the job market, as follows:

The most difficult and pervasive problem in the administration of job description and evaluation in the Pacific Coast aircraft industry arose from the frequent conflicts between measures of external and measure of internal equity. The price of a

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5. Kerr, Clark and Lloyd H. Fisher, "Effect of Environment and Administration on Job Evaluation," Harvard Business Review, May, 1950

job in the market is one well-established measure of its worth. The Southern California Aircraft Industry plan established a different measure of its worth. The conflicts between these different standards made for continuous obstacles to the consistent administration of the plan.[6]

I believe it is reasonable to conclude from the preceding that rigidity in administration of standard practices is in general not desirable or feasible despite the attractiveness that "pat" methods and formulas have in administration. Flexibility is vital, so that it is not necessary to abandon the practice entirely when conditions change although accuracy and precision of results are partially sacrificed. It is apparent from the above discussion that standard practices are continually under pressure, in a sense on the defensive. They must compete with new concepts which may be able to do the jobs better, just as old machines must compete with new. The objectives within the enterprise may change making a standard practice no longer useful. For instance, Standard Brands a few years ago decided to withdraw completely from the direct distribution of certain of its products. This major change in policy brought a major revision in marketing practices. Likewise, a change in the internal or external environment can impair the usefulness of a standard practice by rendering it difficult, if not impossible, for the practice to attain the objective for which it was designed, as in the Willys and aircraft company examples cited above.

I am familiar with one situation where the mere challenge of the job evaluation system in the plant by the union revealed that the plan was entirely unsuited for the type of operation. A standard plan for large companies had been taken over without change, applied in a small one with only 30 employees and used for two years with apparent satisfaction. Upon examination, it was revealed that the job descriptions were at considerable variance with the jobs as performed. The job descriptions for each grade were so vague and differentiated so slightly from each other, that at best it would be most difficult to slot workers. It turned out that a plan that apparently worked, upon challenge became unacceptable almost overnight. What I am saying is that standard practices can and do become obsolete.

How do we know when a standard practice is obsolete in any one situation? What criteria are there to determine obsolescence? What scales of measurement can we use to decide whether the criteria have been reached? There are no ready answers to these difficult questions. Fortunately in some situations, we need no criteria of obsolescence and no rules for measurement. The obsolete practice, usually of a simple nature, is quietly dropped, forgotten and replaced by another more suitable. I have suggested above certain criteria indicating obsolescense, namely

(1) loss of acceptability, (2) the practice no longer achieves the aim for which it was designed, and (3) new competing concepts do the job better.

Recognition of any of these forms of obsolescence and a change made before, figuratively speaking, the roof falls in is another matter.

One of the greatest obstacles in the way of changing or eliminating a practice is that people attain a vested interest in the practice. If they feel their position or security threatened, the tendency is for them to cling to it desperately, refusing to acknowledge that it is outmoded. For them it is still significant. Alternatively those who have a heavy stake in a practice may attempt to force favorable results even though the main objectives of the enterprise must be bent to make it possible. I can think of a number of examples but shall cite only one.

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6. Ibid, p. 81.

At Boeing Aircraft after the war there was a clash between the job description and evaluation system and plant wide seniority. There were a large number of jobs each narrowly specialized which appeared to work out well when the need was great for rapid expansion of the labor force. However, when employment dropped off the situation became chaotic between the extensive bumping rights with a stipulated 30-day training period in his new job and the narrow training of each individual. During the two years of negotiations an effort was made at one time by some union leaders to institute a program of broader job training and seniority rights within related occupational groups. The suggestion was vigorously opposed by those with something to lose. Senior employees would have lost their completely protected job security and junior employees were afraid they would be unable to broaden their narrow skills to fill the new requirements. This conflict led to a five month strike after a decade of satisfactory relations between the parties.[7]

The introduction of new concepts in standard practices is not likely to be nearly as explosive although their introduction may not be simple. New concepts are accepted only gradually due to a general unwillingness to change and lack of receptivity to new ideas. It took approximately twenty-five years and a World War, with active government promotion, before statistical quality control and scientific sampling procedures were broadly accepted. In the early stages of new concepts, they are generally welcomed only when there is dissatisfaction with old practices. They are not welcomed because of their demonstrated superiority to old practices but because the old practices are already obsolete, in that they are not accomplishing their objective. We might go so far as to say that generally there would be no new concepts if the old practices were not unsatisfactory. Once the new concepts acquire the prestige of standard practices, competition may force their adoption. To put it another way, the obsolescence of the old practice is finally recognized and action is taken to displace the old practice.

In one final word about obsolescence, I should like to point out that since the criteria and measurement of obsolescence of practices are vague, constant vigilance at the beginning stages of obsolescence is essential. Efforts can be made then to bring out about changes gradually in order to adapt the practices to the new conditions before a radical sudden change, with all that it connotes, is deemed necessary. If conditions change drastically or the new concepts depart radically from the old, patching up the old practice in an attempt to adapt it will gradually prove fruitless. A frank acknowledgment that the practice is obsolete and should be eliminated or replaced is an initial step in the right direction.

In summary, standard practices do fill a real need and have contributed to progress in that they furnish tried and tested rules of procedure to attain certain objectives. However, results of practices can be predicted with a great deal more accuracy and precision when dealing with material objects than with human beings, since material objects are more amenable to the establishment of a stable and controllable cause system. Engineers, beginning with Taylor, have endeavored to impose a similar system on humans with indifferent success because a rigid system is generally unacceptable in a free society. Even the pace of the assembly line is a matter of joint determination. Acceptability precedes predictability. Only the automatic factory promises to furnish accurate and precise predictable results. The task of obtaining predictable results in human systems is a formidable one because of the difficulty or impossibility of controlling key variables, which may be in either the internal or external environment. Constant changes in variables put standard practices under continual pressure. Likewise new competing concepts call for a re-examination of current practices. Both changes and new concepts can bring

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7. For a more complete description of this situation, see Kerr and Fisher, op. cit., pp. 86 and 87.

about the obsolescence of standard practices. Some criteria indicating obsolescence include

(1) loss of acceptability, (2) the practice does not achieve its objective, and (3) new competing practices which can do the job better.

Changing or eliminating an obsolete practice is another matter. Those with a vested interest in the old practice will often bitterly oppose change or elimination. On the one hand continuance with an obsolete practice can be a serious obstacle to progress. On the other hand the elimination of a deep-seated practice may lead to an explosion. The time to make changes, if possible, is at the early stages of obsolescence and not in the latter stages when the philosophy of gradualism may be unacceptable. Thus constant vigilance to note signs of obsolescence is vital.

The introduction of new concepts in standard practices is not likely to be nearly as explosive as the sudden elimination of old, deep-seated practices. New concepts generally are not accepted initially because they can do the job better but because there is dissatisfaction with the old practices. However, as the new concepts gradually become accepted as tried and true standard practices, their use may be brought about by competitive necessity.

In conclusion, standard practices to be of greatest usefulness must fill a number of specifications: (1) They must give results that are predictable with some precision and accuracy; (2) They must be acceptable to those to whom the rules apply; and (3) They must be administered with flexibility in recognition of the fact that all significant variables cannot be controlled. These goals are not mutually consistent and hence compromises among them are necessary.

MR. TASHJIAN: Once again Professor Lesser has touched on many of the problems that are very close to us. Our third speaker is Mr. Harold R. Nissley(*), to whom we are all very deeply indebted since he has furnished all the audo visual aids that will be used during this conference. His subject is "BRINGING THE COST OF JOB MOVIES INTO LINE WITH RESULTS"(**). Mr. Nissley(*) -

MR. HAROLD R. NISSLEY(*): Thank you Mr. Tashjian for those kind remarks. DEFINITIONS. Let us minimize misunderstandings here at the beginning by defining my subject - particularly the key words in that subject.

1. COST. Cost is one of the most nebular terms in business today. For our purposes, let us focus attention on two concepts: (a) tangible costs; and (b) intangible costs. The tangible costs of shop movie taking are, of course, the cost of raw film (and processing charges, if negative stock is used). The tangible costs would also involve the daily wages of people directly tied up or involved in the movie-taking project. The intangible costs of job movies are possible work slow-

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downs because of lights and other gear set up around production departments. These intangible costs would also include the interest, repairs, and depreciation on camera and projection equipment in taking and showing job movies. Such costs would also include the time of foremen, union stewards, and others not directly connected with the shooting of the movies but whose counsel is solicited from time to time. In other words the intangible costs are all of the other costs not included in the tangible or easily traceable costs.

2. JOB MOVIES. A job movie as used in this paper is a non-professional 16 mm. movie in either black and white or color. To be sure good 8 mm. movies have been taken and are taken even today. A job movie as used in this paper will not include high speed 16 mm. movies; nor will I include the time-lapse movies of John Ott or Dr. Mundel. All of these are important parts of the whole pattern of on-the-job movies. But I should like to confine my remarks to the scores of conventional low-cost movies that have come within my own experience within the past decade.

3. RESULTS. Results, like costs, are difficult to define and difficult to measure. Like costs, we can break results down into two parts: (a) tangible or easily traceable results; and (b) intangible or indirect results. The tangible or direct results are those money-saving or traceable effects from on-the-job movies. The intangible results are the indirect or long range results growing out of such movies.

WORK SIMPLIFICATION APPLIED TO INDUSTRIAL MOVIE TAKING. One of the areas where the industrial engineer has had difficulty in recognizing where the point of diminishing returns sets in is in the area of job movies. Typically the industrial movie enthusiast makes two errors when embarking on an industrial movie-taking venture: (1) He insists upon having a complement of cameras, gadgets, and lights that converts a simple job movie into a "production." (2) He takes so much time in shooting the movie that daily production figures drop sharply due to the distractions of floor conferences and equipment.

As a movie enthusiast I must plead guilty to the first of these errors. In 1943 while teaching, I got permission from my wife to spend $75 for a movie camera. The camera I finally bought cost $175 and within six months I had something like $1,000 invested in equipment and films. On a college professor's salary this was going into the business at a fast pace. Fortunately I was able to amortize this capital expenditure within a short time because of some part-time camera work I was able to pick up at the time.

Despite the way things worked out for me I still think this all-out movie effort was not a wise decision. It is far better when contemplating a new and rather expensive tool such as job movies involving camera and projection equipment to borrow or rent the equipment or have one of your own employees who has home movie equipment to take your first pictures. Indeed, there are scores of professional movie producers who will produce a 4 to 8 minute movie for you for as little as $100; and a few consulting firms will include movie-taking as part of their services thereby bringing the cost of such movies to half of this amount when they are incorporated within the consulting day.

My early movie-taking career has taught me a lot about such movie gear. Ten years ago I would walk into a place with half a dozen cases of equipment and proceed to unpack and set everything up. This took time and caused some "side-line head scratching." Gradually I developed an industrial engineering philosophy toward my movie work--the same philosophy I was trying to inculcate in others. I constantly asked myself: "Is this piece of equipment really necessary?" By eliminating, combining, and re-arranging parts of the movie-taking job I have been able recently to get all of my movie gear into one zipper case, the total weight of which is 23

pounds. This gear or equipment includes one movie camera, light meter, six foot tape, range finder, half dozen rolls of film, small screw driver, small oil can, lens filter, 30 foot extension cord, small title board and a set of ½-inch plastic letters, three General Electric R-2 photo flood lamps and three clamp-on type lamp holders. The lamps are screwed into the sockets ready for instant use, if need be, except for the removal of felt hoods which protect them when inside the case.

LIGHTS. Because I generally use extra fast film and an f/1.5 camera lens I seldom use any auxiliary lighting. I carry the lights with me for use when I am using film that is 5 or 10 years old or for shots where the lighting intensity is below 2 foot candles. Many of my movie contemporaries take exception to this departure from good lighting and sacrifice of "depth of focus." But I continue this practice for several reasons:

(A) Every time you set up lights you add from 10 to 15 minutes to your movie set-up time. This obviously increases the intangible if not the tangible costs of your movies.

(B) Lights are distracting to the subjects involved as well as to nearby operators. Moreover, when an occasional one breaks the explosion adds to the commotion.

(C) High wattage movie lights are an additional load on departmental circuits. All experienced movie takers have gone through the embarrassment of shutting down a department because of an overloaded circuit when movie lights are thrown into the circuit. I can think of no better way to discourage job movies than temporarily interrupting production while someone locates first the switch box, then the damaged circuit, and finally the proper fuses to put current back into the department once more.

So despite the ridicule of my camera friends (and I am no camera expert) I reserve auxiliary lighting for those extreme cases where the odds are greatly against my getting a fair picture. I am willing to sacrifice picture quality for speed and other considerations.

TRIPOD. Another time saver which I have incorporated in my movie taking is the elimination of the tripod for 95 per cent of my movies. Here, again, my 16 millimeter movie contemporaries and I part company. They say you can't get good steady movies without a tripod. I attempt to overcome any unsteadiness of the hands by placing my camera firmly against my forehead and then holding my head rigid except when panning. This elimination of the tripod for most of my movie work accomplishes three ends:

(A) It saves from two to five minutes in each set-up for new angle shots. (B) It reduces space, weight, and time in transporting movie gear. (C) Ladder and other difficult shots are much easier to take when the camera is unimpeded with a tripod.

FILM COSTS. Because there are very few places that will give better than 72 hour service on processing reversal film I shoot my movies on negative stock -- if I want 24 hour service. This negative film is around $5 a roll (100 feet, 4 minutes running time at 16 frames per second); it costs 2 cents per foot, generally, to develop; and it costs another 5¢ per foot to have a positive print made. Reversal film on the other hand costs $7.00 per roll which includes the cost of developing (by the maker); but this film takes from 3 to 6 days to process in many cases. Color film is comparable in cost to the negative-positive technique just described--it runs around 12 cents per foot or $12 per roll with the processing done at no extra charge by the maker.

There are other advantages to the negative-positive technique aside from the 24 hour service. Negative film can be spliced and edited many times without affecting the continuity and strength of the positive that is developed from it. Moreover, if a positive print is lost or damaged, it can be replaced (at 5 cents per foot); such loss or damage to reversal film would necessitate re-shooting all or part of the movie sequences. But reversal film will continue to grow in use largely because of its lower cost. I attempt to minimize editing difficulties when shooting on reversal film by doing some preliminary planning; I size up the job and attempt to get my shots in the sequence I wish them to be seen when the final movie is shown to interested parties.

MOVIE TITLES. Another expense item I try to minimize is movie titling. There are two kinds of industrial movie takers today: (A) Those who never put identifying titles on their movies--frequently omitting such titles even on the leader. and (B) those who spend hours composing and paying for elaborate title explanations. I take issue with both kinds of cameramen. Those whose main ambition in life is to shoot footage and then forget about what they shot after an initial pre-view of their films are fritting away a lot of time and money. Such films become valueless to a company one to five years after they have been shot because no one is around to identify them. The second class of cameramen I take issue with are those who want to make every movie they turn out a real Hollywood production. These fellows will spend a lot of money on movie titling equipment or spend 15 cents a word in setting up a sequence of title plates. If yourmovie is to be used at a sales convention or for training purposes, then this added titling refinement may be justified. There is, of course, no hard fast rules to follow beyond the rule of common sense: Don't carry any of these refinements beyond the point of customer satisfaction in terms of cost.

I attempt to strike a happy medium in my movie work between these film footage cameramen and the Hollywood inspired movie takers. I carry with me a felt board and a set of white plastic letters; in five minutes I have two to three lines of identifying titles set up on this board. Then I lay the board onto the floor together with one or more of the parts I am about to film--usually a raw part on the left or bottom and a finished part on the right or upper portion of the title plate. At a distance of 4 to 8 feet with my camera held firmly against my forehead I shoot the identifying title before I shoot the job itself. Hence the title will always remain an integral part of the movie unless someone deliberately cuts it out of the film.

TEST OF THE PUDDING. So far I have introduced ideas that are contrary to good movie-taking practice. I have talked about "fair" industrial movies resulting from some of these work simplification techniques. Let us now observe what some of these results are. The first four minute movie I am about to show you was taken less than a month ago in a client's plant; this movie has not been edited in any way so you will see many photographic defects. But are these defects sufficient to detract from the work simplification possibilities which the movie inspires? You can answer this question yourself by the number of job improvements which you can see as the movie unfolds the story. This first movie was taken without photo lights or tripod. The second movie I shall show you was taken about a month ago with lights because I was using film with an expiration date of July, 1944! I was not sure of the sensitivity of this film although it was originally marked: "Kodak Negative, Super XX, Panchromatic Safety" film. Had this film retained its original Tungsten value of 80 I would have not used auxiliary lighting.

RESULTS OF JOB MOVIES. So far we have dealt mainly with the costs and techniques of job movies. Now let us look at some of the results.

CASE I: PACKAGING OPERATION. I was completing a standards assignment on a job a few years ago and had taken a few movies when the superintendent met me and asked if I had any film left. I told him I had two rolls left which would yield about eight minutes of operation time or action. He told me his engineers had knocked themselves out in setting up a packaging job; he thought, therefore, it would be a nice gesture to them, if I took a movie of this new job design that everyone was so proud of. When I started to shoot this job there were two things about the job design which I did not like. It was a Friday afternoon and I had plane reservations back to Cleveland late that afternoon. To correct these two defects would require several hours of work. Finally I decided to risk the two rolls of film on a faulty though new job design; I was sure I would think of a tactful solution to this combination design and personnel problem by the time I reached Cleveland. But by the time I reached my home base the solution to this double-edged problem had not occurred to me. A week later the film came back from Rochester processed and I previewed the pictures to see how they came out. Much to my surprise I discovered three other job design defects in addition to the two I saw on the production floor. I was on the verge of analysing the entire 200 feet of film--frame by frame--and writing an engineering report on my analysis pointing out the percentage of time spent on productive work and the percentage spent on non-productive work when I caught myself. Surely there is a better way of selling these five ideas to this proud bunch of engineers and production men than this report approach, thought I. Suddenly I discarded the expert report idea in favor of sending the film to the superintendent without the benefit of my ideas at all.

Two weeks later I received a long distance telephone call from this man. The conversation went something like this: "Has anyone at the home office seen the movie of the packaging job?" "No" was my reply. Said he: "Promise me you will never show that movie to anyone inside or outside the company?" I was a little surprised at this request and asked why: "Well we had a supervisory meeting last night and showed that movie. When the fellows saw the movie they took off their coats and really went to work on that job. When you get out here again you won't recognize the job."

Two things impressed me about this experience: (1) The value of the low cost 16 mm. movie in pointing out job improvements (this movie only cost $14 plus an hour of my time); and (2) the value of the non-expert approach to the adoption of new methods and ideas. I might have derived a moment of satisfaction by spending a day in analysing film and writing an engineering report pointing out the defects to their beautiful new job design. But I derived a greater satisfaction in getting action on a faulty job design even though I received no direct credit for the improved design.

CASE II: OVERCOMING MANAGERIAL INERTIA. The vice president of a branch plant operation was having labor troubles. His home office superiors had tried for two years to move him in the direction of supervisory training--but to no avail. During one of my visits to this plant, the VP took me by the arm and toured the factory with me for a special purpose: To show me four jobs which his engineers and foremen had just brought to completion after three years of patient work. Although I am usually skeptical of new and "perfect" job designs, I was quite impressed with these four jobs. When the VP saw that I shared his enthusiasm for these designs he asked me how I would like to take some movies of them. Usually, of course, I like to reserve movies for jobs which have not been re-designed recently--old jobs or jobs which cannot be readily improved by other more conventional means. But I saw what the VP was up to: He wanted me to show these movies to home office personnel and thus boost his stock and operation. Without indicating to him that I saw through his plan, I agreed to take the movies.

About a week later after the movie came back from the processor I was surprised that the VP insisted that I travel 600 miles to show 16 minutes of movies to his foremen. This could easily cost my employer over $10 per minute of running time. Before refusing this request, however, I thought of a number of other visits I could make in the area of this plant and thus rationalized a visit to this distant plant to show this 16 minute movie of these four jobs.

When I showed up with the movie the VP asked me how I planned to present the film. I told him I would show the movie in any way he wanted. Said he: "Surely you have some ideas on showing industrial movies." I told him I had but most of my ideas were negative. I said I had seen hundreds of man hours of time wasted by calling people away from productive tasks to see a 10, 20, or 60 minute movie; at the end of the picture, everyone gets up and leaves without saying "Boo" and without anyone ever realizing how much good (or harm) was done. Finally, under pressure, I gave him my off-the-cuff answer to this problem. I told him I would be in his factory all that day and in a nearby factory the following day. I suggested we show the movie twice the first day and a third time the second day when I would break away from the other factory long enough to show the movie again. At the beginning of the first showing I suggested that we pass out 3 x 5 cards and ask everyone present to write a question which he or she had on any one of the four jobs; the following day we would collect these cards (as the price of admission). We would request that these cards come in unsigned. Then the VP and I would attempt to answer these questions.

This idea was so novel the VP was surprised that I had never tried it myself. Somewhat reluctantly he agreed to follow the plan and told me to get the cards and explain the idea to his 12 foremen and 4 operators who would be present. I begged off on handling the main bulk of the meeting but told him I would be glad to act as his assistant in putting the meeting on -- running the projector and helping him answer the questions.

The first day everything went off according to plan. The vice president passed out the cards and explained the purpose of the meeting. I took 32 minutes to show the film twice. At the end of the second showing everyone got up and left without saying a word. The VP was firmly convinced that we would not get one question the following day. Although I was not too optimistic myself I did not share this extreme pessimism. I must say at this point that the Vice President's presentation of the whole plan was very enthusiastic; if the plan failed, therefore, it was not due to any tongue-in-the-cheek presentation of the VP.

Both of us were surprised the following day when 11 cards came in from 16 people who attended. But even more surprised were we that instead of getting 11 questions of a curiosity nature we got 20 questions of a suggestion nature. Twelve of these suggestions were adopted on a trial basis at that meeting. As an industrial engineer I was a little embarrassed that so many good ideas came from this non-engineering group -- ideas which had not been detected on the production floor or in my cursory viewing of the movies. I wish time would permit me to relate some of these ideas which this group of operators and foremen came up with on these four newly designed jobs.

Although this meeting, like the one the day before, was scheduled as a 35 minute meeting, we were now running over an hour--and we had not yet showed the pictures a third time as we had promised. Despite this overtime schedule I was anxious to show the movies a third time mainly to give those people whose ideas had been rejected "a second day in court." I told everyone I would stop the projector and freeze the picture on the screen at any point where anyone wished to explain his idea in greater detail. We stoppedthe projector three times while members got up and explained their ideas, blackboard fashion.

When this second informal conference was over and everyone had left, the VP was both surprised and thrilled. He was surprised at how much hidden gold he had in his own people by the many money-saving ideas which they had come up with. He was thrilled at his new experience in leading a plant conference which his home office superiors had been trying to get him to do for two years.

He then asked me to help him program a series of meetings for the remainder of the year. Since then he has been holding two conferences a month--without my help, I might say. The movies, the four job designs, the 3 x 5 cards and questions, all fitted into a perfect educational pattern that accomplished in two days what this man's home office superiors seemed unable to do in two years of prodding.

CASE III: WORK STANDARDS DISPUTE. Several months ago a production standard was in dispute and management thought the dispute might move to arbitration. The company thought it would be both convenient and convincing to show an arbitrator just how easy the job was by demonstrating it in a movie. Although this movie was the first that had ever been taken in this company, the local union officers had consented to taking the pictures. Following my usual precaution in such matters I checked this union acquiescence myself explaining to the officers the extent and the purpose of the movies--to help prove or disprove the position of one side or the other.

I was, therefore, surprised when I was stopped before I was through shooting the job. Apparently the district union officers heard about the pictures and told the local officers that the district would wash its hands of the whole case, if movies were taken of this job. The local officers faced with the alternative of trying to win their case without the help of the district officers or reneging on their movie promise, decided on the latter. Feelings were so strong that management did not wish to risk a walkout by continuing the movies so I was told to stop.

Obviously this movie failure did not do me or industrial movies any good. But the experience did teach me something I should have learned long ago: Never introduce a new tool such as movies when tempers are high; it is hard enough to get by with your day-to-day tools during such strained periods.

SUGGESTIONS FOR NEWCOMERS IN THE INDUSTRIAL MOVIE FIELD. 1. Reserve movies for the pay-dirt areas--jobs where there is a large labor content or where the potential savings are great. 2. Use movies for short cycle jobs which cannot be readily analysed in other ways. 3. Use movies for major selling efforts such as the adoption of a new work measurement or work simplification program. 4. Give your management a sould estimate of the time and cost of shooting movies in your plant--and define what your costs include. 5. Don't buy a lot of movie equipment until after you have proved your movie technique; better borrow a home movie camera or have some local movie producer take your first pictures. 6. Try to measure the results of your movie endeavors by some such means as illustrated in the first two cases above. 7. Inform all interested parties--in advance--of what you plan to do and what is expected of them; and the true purpose of your movie. 8. If possible, inspect the site of the movie "location" in advance so that ladders, adequate lighting, and other gear will be readily available thus causing a minimum amount of delay and confusion. Will there be enough production material to last throughout the shooting time? Is the floor clean and other items in good order? 9. Check all photographic equipment ahead of time. Don't keep operators and machines idle while you return to your car or department to obtain a different lens, a light meter, more film, or replace a burned out photo lamp. 10. If the subject to be photographed is likely to be controversial, be sure that a representative from both sides is present to witness the filming and to hear any instructions that are given.

CONCLUSIONS. It is possible to keep the cost of shop movies in line with results. To do this the industrial engineer must sacrifice photographic finesse (and expense)

for results. If the engineer will keep these costs down, a new era of work measurement and work simplification possibilities are open to him. But if he becomes too engrossed in Hollywood techniques, he becomes the victim of "photographic perfectionitis" which management is as yet unwilling to pay for--and for a very simple reason: Management is not easily sold on intangible or invisible results of the added costs that go into extra job-movie effort.

Cameras and other movie equipment are becoming better and simpler. Whereas the Gilbreths usually employed a truck or a large touring car to carry their movie equipment around (largely because of its size--35 mm), it is possible to do acceptable job movie work with modern equipment that can be contained in a zipper traveling bag--the total weight of which should not exceed 30 pounds. The industrial movie is no longer the special tool of the professional movie producer or even of consulting engineers like myself. It is a practical tool that can be as productive and as helpful as the stop watch itself; one firm alone has taken a movie of every job they have set a work standard on in the last seven years--a total of 6,000 low cost short-run movies. Any industrial engineer who has not experimented in recent years with this newer engineering and sales tool has a rich and rewarding experience awaiting him.

SOURCE ACKNOWLEDGMENTS. Although this paper was especially prepared for the Fifth Annual Conference of the American Institute of Industrial Engineers, the author wishes to acknowledge sources which elaborate on some of the material presented herein: "Using a Movie Camera in Setting and Selling Production Standards", MACHINE AND TOOL BLUE BOOK, September, 1951. "Sixteen Millimeter Industrial Movies", MILL & FACTORY, December, 1948.

FIRST SESSION CRITIQUE AND CONCLUSIONS: Theme--"New Concepts Of Old Practices"

PROFESSOR LESSER is the recipient of the first question, from BOB BEALS - "Of the Systems Engineering Department of the Chrysler Corporation. "You said that there must be an element of dissatisfaction if new system (or concept) will be accepted. Are systems or methods people to allow an inefficient method to continue just because employees are satisfied with it, or can we introduce new methods through - (a) consulting with employees concerned or (b) selling employees concerned?"

PROFESSOR LESSER: My answer is a resounding yes. I did not mean to imply that satisfaction was a one-way street. What I meant to imply was that satisfaction or dissatisfaction can be on either side of the street, and if the firm believes that some particular practice is not fulfilling its aims, then by all means they should do all the things suggested in that question.

MR. TASHJIAN: Professor Lesser - we have another question, "What do you think of setting a line by collective bargaining? I have never done this."

PROFESSOR LESSER: Do you mean the -- pace -- of the line? I presume that is what is meant. I have seen that done. In fact, in my experience, I was called upon to do that, and I refused to do it. I was an arbitrator on such a case. They said there was a three months' slow-down on the operation, and the company thought that the people would gradually get over the idea that the standard was too tight. But as time went on, the assembly department was loaded to the skies -- as it turned out -- with unassembled zippers. The parties asked me to set a new standard, without ever seeing the operation at all. I asked, "What number do you think is a good one?" In effect, I pushed them together to decide what they considered was a good standard, which turned out to be a little looser than I would have guessed, but both thought it was very acceptable. I know some firms that take the attitude that they

would prefer to come to a conclusion by this kind of method, although they initially do set the pace. In one case I had recently, the pace was set and there were great objections to it. The company and union talked things out, and made a revision of it. You should see what great amount of productivity was released once that bargaining was over. The company just could not make them do anything until a 7% revision was made, and then the employees "went to town", whereas for about a couple of months there had been little done.

MR. TASHJIAN: Professor, I have the $64.00 question -- this is from MR. REIGLE -- "Assuming that one must deal with human beings who have a natural resistance to change, how can one insure acceptability of a new practice?"

PROFESSOR LESSER: The only way I have been able to do it in my own experience, and I think many of you can check me on it, is that I usually mention the new ideas to the group. I know they will talk me down. I do it expecting that result. But I also know that they are going to think about it. Of course, if I am going to talk to those above me, I usually find that it is a good idea to have something written in addition to my talking, for I have lost some excellent cases by not having something they could see.

MR. TASHJIAN: "Could part of the answer to the obsolescence of the incentive system as a standard practice be a system of frequent audits and corrections of time standards?"

PROFESSOR LESSER: If you can get away with it, I think it would be a good idea. I should say that one of the most difficult problems, as you all know, is when you have these minute changes, none of which are important but which gradually build up, and then another change is made. Attempting to revise the standard at this point introduces many difficulties. I have had several talks about that with Mr. Carl John and I don't believe we ever came to much of a conclusion, except to try to put boundaries with a pretty tight clause in the contract, which will show that there can be revisions in standard practices. I have found that the human element is becoming a more important part of industrial engineering than many of us believe.

MR. TASHJIAN: This question, Dr. Villers, follows the last question asked of PROF. LESSER - "In large companies, practicing decentralization management, isn't there still a close co-ordination of policy required, especially in personnel department, in order to avoid one plant creating problems for other member plants in other locations.

DR. VILLERS: Of a necessity, there is a limited scale down, of an already sizeable operating unit. You cannot operate economically a small unit. A unit that operates economically must include depending upon the kind of specialists that are needed on the staff, must include probably a few hundred men at the very least and maybe quite a few thousand, and within this unit geographical decentralization is not possible because you cannot put the engineering department 500 miles away from the plant, nor can you put the tool engineer in the middle west if the machine he is going to equipt is in the east, so that geographical decentralization does not take care of the need for giving more deference to a smaller group of men, which functional decentralization attempts to do.

MR. TASHJIAN: "To what extent does the Plant Manager exercise control of the individual's freedom in phase of the decentralized organization?"

DR. VILLERS: The whole idea of functional decentralization which can exist within the geographical decentralized area, is to functionalize planning and control. In the question about the Plant Manager - now the Plant Manager and how he decides the

control of the various functions of engineering, planning, etc., the idea is to organize a set-up in which all can work in their own world, independently from each other, one and each having a task assigned by the planning and control department. The major objection that can be made, and has been made, is that you may create a degree of specialization in which every one would be so narrowly specialized we lose the whole perspective of the whole group of which everyone is a part, and this objection is valued and has to be answered. The answer to it is that everyone has a definite and somehow narrow field of responsibility, but everyone at the same time is kept informed of what is going on all around. Precisely because of the decentralization of planning and control everyone can be informed of what everyone else is doing, and this is the problem of communication within the organization.

MR. TASHJIAN: The second part of that question is "How does the Plant Manager's control differ from the General Manager?"

DR. VILLERS: Well there is a question of terminology involved there; however, the Plant Manager is the man who is in charge of producing. Now in the concept of functuralized decentralization, the Plant Manager is merely in charge of producing ways that are designed for him, with him being consulted (this is the communication that I was mentioning just before) but still the tools that are not made by him but for him, the materials are not only purchased by the Purchasing Agent, but delivered to him, possibly by the Dispatching Department, and the men are being placed under contract, Labor Relation or generally organized by the Personnel Department, and again he should be consulted, as his responsibility is to produce ways, the tools and the machines and the material that are delivered to him, with men that are paid by the payroll department, produced according to a schedule of production, indicated to him by the Planning and Control Department. The General Manager at the higher level is in charge of the whole unit, and is in charge of co-ordinating the activity of all the other functions outside of the plant with the activities within the plant, and in addition to this job, I think it might be worth mentioning that the big task of a General Manager, like the big task of any leader, of any unit, large or small, is to create the climate within which the men and everyone is going to work, whether there will be a lot of politics, or whether politics will be kept under control, whether there will be a team spirit or not. This is to the credit or to the debit of the General Manager or the leader of the unit, so in answer to the question, I would say this is the primary function of the head of any unit, large or small, of any corporation or operating unit to see that the co-operative spirit or team spirit can be carried out.

MR. TASHJIAN: Dr. Villers, this next question is one that you have wanted I know, because with your Management Consulting firm, you can answer this one. "When a company's situation indicates the desirability of decentralization - how should they proceed with the planning - and the implementation?"

DR. VILLERS: Well, this is a problem of re-organization. If I may inject a personal element, I met Professor Lesser in Dartsmouth at a meeting, and during conversation I said, "You know all this work that is being done about teaching industrial organization, about writing books about organization, and I have never been called upon to organize anything and I doubt if I ever will, and I don't know anyone who has ever been called by a group of men to ask me 'Would you set up a nice organization for us?' I say the problem is always a problem of re-organization, and I think that is the type of question you ask here. I think it is something that we will learn that the attention will be concentrated precisely on the problem that you mention here, "How can we introduce improvements," and this is also related to what Professor Lesser was saying about the difficulty of changing, which is precisely the problem of progress that you are asking, and I think that it should be - how can we progress and improve the condition. Well I would say there are two

questions there - first, we have to know what we want to do - and this is a technical problem - and one which we have discussed in the first part of this session - what should be done is one thing and then how to gain the co-operation of everyone. You first have to show them what advantage they are going to derive for them and the company in reduction of cost, and more efficient operation (and that is easy to show) plus the advantage of the individuals concerned, (and that also, must be done) because honestly this discentralization is for the greatest benefit of the individual concerned as well as for the benefit of the organization."

MR. TASHJIAN: "This next one," Dr. Villers - "In a large decentralized organization, is there a problem in obtaining close co-operation between elements of the same department in order to prevent different plants working under different policies?"

DR. VILLERS: "In large corporations generally what is being done, is to have certain functions represented at the headquarters (like Personnel Dept.) and in charge of co-ordinating the activity of the various personnel departments in the decentralized units. This is true also for planning and control. When you have decentralization of control you have a central control department and decentralized control departments all over. This state of decentralization between the function of the headquarters and the function of the decentralized units should go thru the General Manager of the decentralized unit or thru the rightful agency. I have studied that program very carefully in various large corporations and with various functions and I don't think there is any definite answer that can be given. The policy varies with the organizations, and with the functions, for instance, (and this is public record - I am not revealing any secrets in saying this) - at General Motors where the policy of decentralization has been very extensively pursued, it is a matter of principle that all functions are decentralized. That means that the General Manager of the operating unit, acts hiw own way if he wants to; except, however, for financial and legal functions, the financial man is the General Comptroller of the headquarters, who has the privilege of contacting directly the comptroller of the decentralized division. The same is true for legal aspects. In another corporation for instance, the same is true of the Purchasing activity, and for the Labor relation activity. They are all entirely centralized to create uniformity, so I don't think the answer can be given in general. It depends on the policy of the particular corporation. That is what I have been able to ascertain by doing some research work on this point."

MR. TASHJIAN: "Dr. Villers, I think you have already answered this last question regarding, "How does the planning and control department work, and would it be worse than nothing if it didn't work?"

DR. VILLERS: "Yes, it is such an effective tool, let us put it this way. You know, of course, that a non-effective tool does not go a good job, but it is not dangerous either. A very effective tool, if it is misused, is awfully dangerous. There is nothing more powerful than an atomic explosion, but it can become a blessing for humanity if we know how to use it. If we misuse it, it is going to be tough, and this is true for everything that is really powerful and effective - it can be awfully dangerous - and definite. I am glad that you asked this question, because it gives me another opportunity of stressing the possible danger in establishing a tight control. It can easily become a source of irritation and therefore make life impossible. But because controls are greater, executives are more secure. They are more relaxed, because they know the activity of their subordinates is going to be controlled, so that if it is property used, it may become a means of giving a much greater deference because their superior will know that their defiance cannot endanger the organization. Therefore they will be willing to give them a much greater freedom of action which is after all the main purpose of this concept of functional decentralization."

MR. TASHJIAN: "Thank you, Dr. Villers. Certainly a decentralized organization is very important to us all. I think of our own situation in Reynolds where we have some 35 or more plants geographically decentralized, and in the organization decentralization, the planning and control and in addition to that, all the service groups, (legal, personnel, engineering, industrial engineering, etc.,) have a control unit in the main office. Then each plant has its own representative of those functions, who assumes the responsibility and authority at the plant. It does present quite a problem; in fact, as Professor Lesser said, it needs human engineering to make it work. Now we have questions for Mr. Nissley.

MR. TASHJIAN: "Why has film use in time study been so little used? Is it excessive cost or lack of selling on the part of those using film?"

MR. NISSLEY: "That is a good question. I think it is probably a little of both. The cost has gone up in many cases far beyond what it should be. I said earlier that I started out in my own movie work selling my wife on the idea of spending $75 for a movie camera; I ended up by buying a $175 camera and over $800 worth of other equipment and films within a 12 months period. Fortunately I was dealing with my wife and not a company president or a realistic works manager. This personal incident serves to illustrate what the embryonic movie enthusiast is apt to do when he goes "hep".

The second part of this question having to do with the selling aspects of film work is very important. Today there are thousands of dollars worth of good movie equipment and film in shops all over America not being used because local industrial engineers and personnel men cannot sell the end product--the use of films for work simplification or work measurement problems. There are several reasons, of course, why such tools are not sold to management and to the union (aside from human inertia). These reasons are pretty well covered in the literature and would take more time than I now have to cover them.

But the use of the 16mm. on-the-job movie is growing. I believe I am correct when I say there is 10 times as much 16mm. film footage sold today as was sold in 1939 before World War II. The sale of projection and flood lights has sharply increased, too, as well as camera and projection equipment. I mentioned earlier one firm which has taken over 6,000 low cost shop movies since 1945; I doubt whether this firm averaged over 10 such movies a year before 1940. But this firm has reduced the cost of these movies in various ways so that today the average film cost is around $3.00 per job filmed (average footage per job about 50 feet).

Incidentally a new movie producer in Cleveland is willing to produce some shop movies at no cost to the manufacturer, if he can gain the right to use such movies for work simplification and work measurement purposes; the manufacturer, of course, would receive (at no cost to him) one print of each such movie taken. I'll be glad to give anyone in the Greater Cleveland Area more details about this after this meeting is over."

MR. TASHJIAN: "What, in your opinion, would be the cost of the minimum necessary equipment in taking job movies? By that I mean, projector, cameras, lights, etc."

MR. NISSLEY: "That, too, is a good question. I would say that at today's prices the cost of what I have in this case would probably run around $400; this includes a zipper carry-all bag; a movie camera with an F1/5 lense; a light meter; three flood lights and sockets; and a set of 1/2 inch plastic letters and a small felt titling board.

The projector which I used to show my film today is primarily a sound projector; but a rheostat on it enables me to project silent pictures at 16 frames per second

instead of the usual sound speed of 24 frames per second. Such a projector costs around $400 in today's market ($250 if you have a very good friend). But Dr. David Porter modified a Keystone projector for time study purposes which he sells for something like $190; this projector is equipped with an odometer for frame counting (hence time determination); it has a forward and backward remote control switching mechanism; and it has a variable speed rheostat that enables the projectionist to project from 600 to 1800 frames per minute which makes it ideal for rating sessions.

In answer to this question, then, I believe anyone could "set up shop" at today's equipment prices within a $500 to $700 range.

MR. TASHJIAN: "Do you always use job movies in getting foremen and supervisors to help suggest changes?"

MR. NISSLEY: Obviously I can't and I don't always use movies for motivating foremen to improve jobs. But where time will permit and there is enough work content to warrant taking some short low cost movies, I prefer to use them instead of my direct suggestion or the expert approach; in other words I prefer to let the foreman come up with the "good ideas" after seeing some of his jobs on films rather than pointing out job defects to him out on the production floor. To illustrate this point further: I did not have to enumerate the many job defects to the two job designs I showed to this group earlier in my main talk; I am sure, too, that if time had permitted, you people in the audience would have developed far more improvements in these two jobs than I have been able to think of as an individual "expert" on each of these jobs.

In addition to getting more and usually better ideas from a group of foremen (or operators) than I can usually conjure up there is the psychological advantage of group participation. Any foreman who has had a part in the improvement of a job in his department will take more pride in that job and its future development than when he is by-passed by the eingineers. I have taken close to 300 movies in the last 11 years of the 2 to 8 minute variety. I believe I can accomplish more with such short movies than I can without them.

MR. TASHJIAN: "Thank you very much, Mr. Nissley. I assure you that you have excited one company to the use of movies here today. We here from Reynolds are going to use this as a selling tool. That is the part that has impressed me the most. Professor Lesser has said that the men on the job know more about the job than we do (after all, they are performing the work all day long); and this is a wonderful way to get ideas and let them tell themselves what to do. Look at the time and expense it will save in trying to sell the job!"

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SECOND SESSION: Wednesday, May 5, 1954, 2:00 P.M.
Theme: "NEW INDUSTRIAL ENGINEERING PRINCIPLES"
Presiding Officer: Mr. James M. Kalbach, Supervisor in the Management Engineering Service Division, E. I. DuPont Co., Wilmington, Delaware

MR. KALBACH: Gentlemen: -- I believe that the Louisville Chapter of the A.I.I.E. has rather a single honor in its being such a young chapter, and yet that they have been selected for the job of being the host at this A.I.I.E. Fifth Annual Conference and Convention. The theme of your conference is "What's New in Industrial Engineering," a timely one. It is a great challenge to the industrial engineer. The buyers market is gone. We are back in the sellers market. We have reached that point where cost and competition has become more important. This certainly is

a field where industrial engineers can contribute a great deal. We need all of the new concepts that can be developed, as well as the old ones in order to make our greatest contribution. I am here to introduce the next four speakers. It is with pleasure that I present to you the first speaker, The Honorable William H. Martin(*).

MR. MARTIN(*): Mr. Kalbach and members of A.I.I.E., it is a great pleasure for me to be here to give me a chance to tell you about some of the things we are trying to do in engineering work in the Department of Defense. Since I came to Washington, the first of the year, there have come to me many times in various forms the following two questions: What is this thing called applications engineering? and What is the Office of Applications Engineering supposed to do?

The term with the meaning used here, was created in the Rockefeller Report which proposed the reorganization of the Office of the Secretary of Defense, which was put into effect in 1953. This report states that the Assistant Secretary of Defense (Applications Engineering) "....should perform such duties as the Secretary may assign to him in the broad field which lies between research and development, on the one hand, and the quantity production of weapons, on the other. He should examine into and make recommendations concerning new developments as to their suitability for the purposes intended; their reliability, simplicity, and economy of production, especially with respect to their suitability for production by existing machine tools and other facilities; and their ability to fit into a complete weapons system."

Two kinds of situations have fostered interest in this field. One may be indicated by the comment -- why does each Service have to have its own variety of truck and why isn't more use made of the standard commercial article? The other was stimulated by the "crash" program idea under which items were put into production before proper evaluation had been made of their suitability for use. This was fostered by the Korean situation as a means of buying time; often the results were unsatisfactory both as to performance and time. Additionally, there has been a growing appreciation of the need for proper programming of the auxiliary equipment, information and service required for operation and maintenance.

I have heard various discussions as to the suitability of the term "applications engineering" for this field. These carry me back to the time when a London taxi driver took me to Hyde Park to see a statue by Jacob Epstein. When he got me to where I could see it, he commented, "there are them that likes it, and there are them that don't." However, the term is official now and it is up to us to make what it means recognized and effective.

A minute ago I mentioned two questions. There are two answers -- and they need to be distinguished -- about the use of the term "applications engineering". The use of this term involves two concepts; one of applications engineering as a practice; and one as the function of an office in the staff of the Secretary of Defense, which has been given this name.

PRACTICE OF APPLICATIONS ENGINEERING. Broadly, applications engineering as a practice calls for doing the many things necessary to make an item suitable for production and use at a proper cost. A more definite statement may be made along the following lines:

(*) Deputy Assistant Secretary of Defense, (Application Engineering), Department of Defense, Washington, D. C.

Applications engineering covers the consideration of the factors and procedures which affect the attainment of the projected performance results, with the general objectives of minimum kinds of equipments and systems, and of least cost, effort and time -- all in proper balance. The more specific objectives of applications engineering are: 1. Simplicity of device and operation. 2. Reliability. 3. Producibility. 4. The use of standard and available materials, components, facilities, processes, methods, and practices. (This includes the conservation of critical material.) 5. Quality control in production. 6. Suitability for use in a system, under service conditions and locations, and for the capabilities of available personnel, and including compatability with associated equipment and systems. 7. Facility in setting up, installing and transporting. 8. Ease of maintenance. 9. Ease of modification for various applications and for improvements. 10. Timely availability of information, auxiliary gear and spare parts, for operation, adjustment, maintenance and training of personnel.

Along with all this, there should be a continuous scrutiny, to the extent practicable, of the justification of the specific cost of realizing each result, objective and requirement. All these taken together show quite a range of material in this broad field of the Rockefeller Report.

Generally, most of the determinations as to the manner of meeting the objectives of applications engineering will come in the stage of the specific development of the design for production (which for brevity will be termed (design development"), and for best results, these determinations require close coordination then with the factors of production and use. Consideration of means for meeting these objectives can start, however, in the early development stage, and some of the arrangements for meeting them will take place in the procurement, production, supply, logistics and use phases. The phases in which the work is done for meeting the various objectives of applications engineering normally vary for different projects, depending somewhat on the state of development of the art in question. Accordingly, the meeting of the objectives of applications engineering will require close collaboration by the three sections of the Office of the Secretary of Defense, namely, Research and Development, Supply and Logistics, and Applications Engineering.

FUNCTION OF THE OFFICE OF APPLICATIONS ENGINEERING: We come now to the second question. The function of the Office of Applications Engineering is to promote policies and procedures which will assure that military equipment and systems meet the objectives of applications engineering, as they pass into the phases of procurement, production and use; and that their suitability for production and use is determined by proper tests and evaluations. For emphasis, it should be noted that as a function, the Office of Applications Engineering is concerned that engineering standards are established and followed, and that a proper job is done in the fields of maintenance engineering and production engineering.

All of this may be summarized in the simplified statement that the goal of the Office of Applications Engineering is to see that the military people get the best equipment for their use, with the least expense to the taxpayer. In recognition of the scope of applications engineering as a practice, the endeavor in setting up the operations of the office of that name, has been to establish a close interlacing with those of the Office of Research and Development and of Supply and Logistics. To that end we each have memberships on the committees of the others. To put all this in another way -- applications engineering is practiced all along the way from research through development, design, procurement, production and use; it is the function of Applications Engineering to see that new things do not get into production and use, until and unless the objectives of applications engineering are met, or arrangements have been made to see that they are met. From these standpoints it will be evident, I think, that those responsible for carrying out this function of

Applications Engineering are interested in promoting a number of things which might be considered outside of the engineering field but which contribute to attaining the objectives of applications engineering.

MILITARY CHARACTERISTICS: To this end, for example, we are interested in the coordination between the several military departments in the establishment of their needs, and with whatever is done to meet these needs. It is desirable not only that the minimum number of items which are required to meet the joint needs of the military departments get into production and use, but also -- in the interest of economy of effort and money -- that the minimum number reach the state of being proposed for production and use. To put this another way, coordination is not just having each Service know what the others are doing, but it involves action to meet their needs with the minimum number of types and variations.

We are, therefore, interested in the coordination between the Services in the establishment of what are called military characteristics in the initiation of proposals to develop and get new things. We are also interested in another phase of military characteristics. There has been a tendency to look upon the military characteristics as set up from the operations standpoint, as being immutable throughout the development and design stages. Some of these, from the standpoint of the user, have to be established as unquestionable. Obviously, a rifle must be designed so that when it is fired it does not explode in the hands of the user. On the other hand, however, certain so-called characteristics should be expressed and treated as desired objectives, subject to exact definition as the result of what is found to be feasible, practicable and economical throughout the research, development, design and production activities. This is to insure that there is a proper balance between service performance and cost, using both of these terms in their broad sense.

SINGLE RESPONSIBILITY IN PROCUREMENT: Another area of interest to those of us in Applications Engineering is the effect which procurement policies and procedures may have on the attainment of the objectives of applications engineering. For example, in the case of new complex weapons and weapons systems -- such as exist or are under development today to meet present day methods of warfare -- it is desirable to get proper integration between the specific development of the design for production and the production process. This means that the design should take into account both the practicalities and potentialities of production and that the processes are developed and utilized, to provide the inherent capabilities of the design in its service performance. To this end in such cases, it is desirable from the applications engineering standpoint to have a single responsibility for this design and production.

This requires that the responsibility be given to an organization which has competence in both the fields of design and production. For an item which is to have large production, it means also that it is desirable that this organization be given an order for a sufficient quantity to provide the opportunity for the establishment of suitable tooling and manufacturing processes to obtain the desired quality of product on an economical basis. It is also desirable from this standpoint to have this production continue not only throughout the user evaluation tests but also into service use so that the changes found necessary or desirable by this experience can be integrated into the design and production, by those who are in position to know the effect of such changes on the overall result. This does not mean, however, that multiple sources of production may not be set up. It points rather to the establishment of a production and a performance, before multiple sources are arranged in an orderly manner.

SPLIT IN RESEARCH TO PRODUCTION PROCESS: This desirability of single responsibility for design and production brings up another matter. In the procedure through research, the exploratory development phase to show feasibility, design development and production, what is the proper point to make the split, if two agencies or organizations are to be involved in this process? Such a split is often necessary, because there are too few organizations which have the competence to cover the whole process. From the standpoint of applications engineering the most desirable point for the split is between the completion of exploratory development to determine and demonstrate feasibility, and design development. This is a better point than that between the design and production phases. The split at the latter point makes very difficult the integration of design and production; in that case this integration often may not occur until after considerable money has been spent in the early production.

AUXILIARY MATERIAL: Going back to the idea of single responsibility, it is also desirable for new complex items to have this initial producer responsible also for supplying the information and auxiliary equipment required for operation, adjustment and maintenance of the item available at the time that prototypes or first production models are put to the scrutiny of the user test.

SYSTEMS CONCEPT: There is another factor in this development--production process which is also in the interest of obtaining the objectives of applications engineering. This is the so-called systems concept which is very much in the picture today. This means that an organization is responsible to the military departments for supplying a complete weapon or weapon system. The purpose of this is to insure that all parts of the system are compatible with each other or properly integrated for best results, and that there is one responsibility for these results.

PROCUREMENT POLICIES: In what has been presented here about procurement policies, it is not the intention to imply that these procedures are not already in use or are to be used to the exclusion of others. Rather, the purpose is to point out that they have important advantages in meeting the objectives of applications engineering, particularly for new complex weapons and weapons systems. It is recognized that many other factors need to be taken into account, on a case by case basis, which may call for other methods of procurement.

MAINTENANCE: One more specific item before I conclude. We have established in our office a section dealing with maintenance engineering. In recognition of the increasing importance of proper maintenance and all that is required to support it -- facilities, instructions, availability of spare parts and training -- with the greater complexity of the tools of war, we are establishing a coordinating committee between the Services. This will, we hope, provide across-the-board consideration of this critical operation at the level of the Office of the Secretary of Defense.

SUMMARY: In general, the carrying out of these factors which have been cited as desirable from the standpoint of Applications Engineering, means the placing of a broad responsibility on the organization which does the producing. Since this production in most cases is carried out by an industrial organization, this means the placing on, and the proper assumption by, this organization of this broad responsibility. In general, it calls for a high degree of integrity on the part of the organization, particularly from the standpoint of doing the job in such a way as to meet best the interests of the using agency -- or to put it broadly -- in the best interests of the boys who are going to use the gear and of the taxpayers who are going to pay for it.

OFFICE OF APPLICATIONS ENGINEERING: This is a new office in the Defense organization. It has been in operation for only a little over half a year. Its objectives, as I see them and have defined them here, are high and comprehensive. Because there is such an organization and attention is being directed specifically to the attainment of its objectives, it cannot be taken that the millenium is here. It indicates rather a greater awareness of and emphasis on the things which need to be done "in the broad field which lies between research and development and the quantity production of weapons."

As you are undoubtedly well aware, this desirable result is not to be attained merely by the activities of this new office. Rather the achievement is going to be one of continued evolution in which the big job is done by the people in the military departments and in industry. Our job in the Office of the Secretary of Defense is a staff job. Our function is to see that the policies and procedures are established to promote the attainment of the objectives of applications engineering and to scrutinize this evolution and the results which it produces, so as to be helpful and give advice to the Secretary of Defense on his actions from this standpoint.

MR. KALBACH: Thank you Mr. Martin. I believe Mr. Martin has broadened the scope of industrial engineering. He carried it from the piece-meal approach which many of us are accustomed to, into the broad application as they might apply all the way from research thru production, into what maybe we would call distribution, or what the Army and Navy might call logistics. I have one question to ask Mr. Martin. That is, in recognition of the fact that your department has been recently established I am curious as to what progress has been made.

MR. MARTIN: This is a new office. We have been in existence only a little more than a half a year. Part of that time has been spent first of all in trying to define the job as I have outlined it. It is a new field, and as many of you probably know. There was in the Department of Defense, two organizations, so called a Research and Development Board, and the Munitions Board. Between them they covered the whole field of research, development, procurement, production, etc. These boards tried to cover comprehensively the whole field of military equipment. I recently learned from the men making out the revised catalog of military items, that they had something like four and a half million items in this catalog, which they hope to get it down to two million. I think one reason why these boards became cumbersomeis because they tried to cover comprehensively the whole array of the military equipment currently and continuously. Our activities being new is really being established between these previous concepts, The Research Development Board and the Munitions Board. We hope to avoid becoming too cumbersom, by not trying to cover continuously and comprehensively the whole field. Rather to pick up those items which are of a critical nature (current critical nature) and on which it is expected we can accomplish some results. Now it comes down to a matter of accomplishment in the way of being able to spell out, certain things that have been done, certain monies have been saved, it is rather early to give any comprehensive figures on that. Security also prevents me from mentioning some of the things we are working on. But the picture we have is something like this. We can't hope in one staff organization to cover the whole field of the three military services, but rather by trying to stress certain procedures. One of them I have mentioned here is the matter of procurement, which I call the single responsibility. Procurement, where the initial producer is preferably given the responsibility of both design and production.

If we can get support for that policy it means that the procurement officers of the services, will realize that they will get support for doing that where it is justified, and not feel that they have to always place their orders in this complex

area, solely on a competitive bidding basis. This has been one of the difficulties in getting the kind of tools that we need today, that you frequently get on a competitive bidding - awards to organizations that are not competitent. Sometimes the reasons their bids are low is because they don't know what the job. That applies both to the design part and to the production part. I have seen cases happen also, along this same standpoint, where one of the organizations has done the design, has put a lot of time and effort and skill into turning out a good design. Then on a competitive bidding basis, someone else has picked up the production. We have had to start all over again. There is not the carry-thru from one to the other. If we can give support to the purchasing people to give this responsibility to a competent agencies, we will have accomplished a lot. Furthermore by picking critical items across the board, we will set precedent we hope which the military people will willingly follow. Rather than our having to attempt to try to cover this field completely. As Mr. Kalbach put it not long ago, in a discussion he had with some of the staff, he used a very simple example of getting the hay in from the field. He said when you get the hay on the wagon, (he used the term wagon, though it may be a truck now) and drive down the road to the barn, some of the hay blows off onto the side of the road. He said, not to worry about that, the main thing is to get most of the hay on the wagon into the barn. I think we have to approach our job on the same basis. I don't know if I have answered your question completely, but I have given you what our present thinking is in this very complex stupendous field. I might say that having gotten into this recently, one of the big factors is trying to find out how to encompass and get some hold on this complex area.

MR. KALBACH: "Do you have any published matter on how you or industry will proceed to accomplish the steps you have discussed?"

MR. MARTIN: The only published material we have so far, is the kind of talk I am giving here today, and one of my reasons for accepting the invitation to come here, was to get to you some picture to you at least, of what it is we are trying to do, and how we are trying to get at it, and the publication in your proceedings will be one such publication. There is however, no instruction book or hand book. I would say however, that at the present time, and before an audience of your type, I would like to quote what I started off with, that this is really recognizing a need for doing a good engineering job. We have heard a lot about the benefits of results in the military field, and I in no way decry the results that have been obtained there, but there has not been enough emphasis on the development of the design and on production itself, so that I think that for the people in this audience, I can say that this means doing a good engineering job across the board.

MR. NISSLEY: Back in 1920 or several years ago, there was a regulation or law to the effect that no government contract shall be let to any firm employing a stop watch for setting standards for work performance, now I just wonder what the present status of that is, or is it one of those laws that died out?

MR. MARTIN: I don't know about this law, and I hope you are not trying to get me mixed up in some labor relations discussion here, but I can assure you that what our purpose is to try to get support for whatever is a good practice for getting the best results, now we have a number of restrictions of which you are well aware, and this is the nature of one of them. We have this matter of competitive bidding, we have the matter of direct contracts for so called small business, as contrasted with sub-contracts. We have the established practice of some of the military and non-military laboratories, research laboratories wanting to get into design, and many of them don't have proper production design people, and our purpose is in so far as we can within these political and legislative requirements to work out a better solution to handling these complex things. Take this illustration, if you

are going to buy clothes pins, you don't have to worry too much about getting a good integration between design and production. It is an established part the field is pretty well known, and you can do it probably on the present basis, but what I am directing my attention at particularly are the complex devices, things like aeroplanes, power control systems, bomb sights, guided missiles, things into which a lot of our defense money is going today, and the things which are really the heart of our defense program, to get those things on a better basis is our purpose. What I say does not apply to the simpler types of things in current industry, as I think that many of the practices that are now followed are appropriate policy, but it has to be recognized that in these highly complex things, they are highly technical and we are getting into fields where the technology is new, the applications are new, and you can't foresee when you start out, just what the results are going to be. Your best bet, looking at it from both the standpoint of the boy in the service, and the tax-payer, is to get a good competent organization, and use them with all their skills to work out the right kind of results, and that may mean possibly some tempering of some of the safeguards that have been put up by legislation around these procurement matters.

I can't be specific in the answer to your question, as I am not familiar with the conditions, I have tried to give you however, the motive and goal we have in mind, now just how far we can go is a big question, but I think we can give a lot of relief and a lot of help in the way of indicating support at the top for the procurement man who wants to use practices which are now permissive, to indicate to him that they are preferred, and in many cases the argument should be, "Why don't you use the preferred method, rather than have you a sound rock-bottom reason for justifying a deviation from some of these practices which we don't like to see."

MR. KALBACH: Mr. Martin we want to thank you very much for taking part of your busy time to come here and be with us today. I believe that especially in view of all the publicity, adverse I believe that is coming out of Washington today, that it should be rather heartening to us to hear that the government is taking these practical approaches to problems that are close to our hearts. I think that we should carry the message of Mr. Martin back to our contemporaries in the field. Let's have a rising vote of thanks for Mr. Martin.

MR. KALBACH: The next subject that we are going to take up is, "Stop Watch Time Study Can Be As Accurate and Salable As Tabular Systems." I am sure that we will all be very much interested in what Mr. H. R. Nissley(*) has to say to us on Stop Watch Times.

MR. NISSLEY(*): Thank you very much Mr. Kalbach - "STOP WATCH TIME STUDY STANDARDS CAN BE AS ACCURATE AND SALABLE AS TABULAR STANDARDS." Now that is quite a mouthfull. Before starting out I would like to again acknowledge the helpful suggestions and criticisms of some very good friends who have previewed this paper, (1) Mr. Phil Carroll, whom most of you know, if not in person, by reputation, (2) Mr. Edward Cyrol of Chicago; Mr. Dickey Dyer, Vice-President of the Work Factor Company; Mr. Ralph Presgrave; Mr. Harold B. Maynard of the Methods Engineering Council; and Mr. John Petro of the Thompson Products Co. This does not mean, of course, that these men agree with all, or even most of what I have to say in this paper. In fact, I can assure you that some of them violently disagree with certain things I say in this paper. But let me preface my remarks here further, by saying that if anyone has come here to hear me settle the current controversy over which system is best

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for setting standards, I'm afraid he will be disappointed. Indeed, I have with me today very little quantitative information that will enable anyone to adjudge one system over another. But even if I had such quantitative data with me, it is doubtful whether a group of practicing engineers would be interested in a statistical analysis of work measurement systems. Such analyses are important; but they are more in the realm of pure science and mathematics and should, therefore, be left to the scientists and statisticians--men who can understand and interpret the results of such investigations. I have, therefore, prepared a paper which I hope will be helpful to senior practicing engineers and works managers in their day-to-day problems.

It will be my main purpose to show what must be done to bring conventional stop watch standards techniques up to a plane of respectable acceptance. My main thesis, then, will be that of advocating higher quality industrial engineering--not merely a change in the "system". Someone once said that no government is ever better than the people supporting it. I'd like to paraphrase this: "No industrial engineering system is ever better than the engineers administering it." Thus, I might sub-title my talk: "Let's Stop Arguing About Systems and Return to Industrial Engineering Fundamentals."

DEFINITIONS. A lot of heat has developed in recent years over the respective merits of stop watch time study and some of the newer tabular systems now in use in some companies. This heat diminishes when disciples of the various systems start comparing notes--especially notes on what each is talking about. Thus the safest starting point in any controversy is to focus attention on word connotations.

STOP WATCH. As used in this paper "stop watch" means a hundredth minute, hundredth hour, thousandth minute, or split second watch with appropriate mechanisms that will permit the user to stop the sweep hand at any point or return it to zero whenever desired. Although the hundredth minute watch is the one most commonly used by industrial engineers today, two of the foregoing watches have finer breakdowns than the hundredth minute watch: The thousandth minute and the split second or sportsman's watches. Thus there are available today at prices between $20 and $30 watches that will measure time fairly accurately to the third significant decimal minute. Of course, the slower eye-hand coordination of the user offsets, in part, this third place accuracy. It is enough for our purposes at this point to indicate that the time study engineer has third place stop watch accuracy potential available today.

STOP WATCH TIME STUDY. A stop watch time study is an elemental breakdown and timing of a job by either the continuous or snap back methods. Selected, rated, levelled, or normal times of both regular and irregular elements are added together to get a "cycle" time.

ACCURATE. What is accuracy? A good engineer or statician knows there is no such thing as absolute accuracy. The most scientific and accurate measuring devices yet created have certain plus or minus tolerances. The tool engineer has learned to indicate what his tolerance limits are under a given set of tooling conditions. Many time study engineers have yet to learn this. Often the time study engineer sets a standard of, say, 100 units per hour and then dares anyone to question this standard. This may be good sales psychology; but its weakness begins to show up when close comparisons are made. Further study of this job may reveal the final answer to be closer to 106 (or 92) units per hour. Had the original tolerance of, say, plus or minus 10 per cent been indicated after the figure of 100, anyone seeing this figure would read into it the same scientific and objective meaning the time study engineer probably intended. Accurate timing may, therefore, be defined as timing elements or cycles within the allowable tolerance limits of the time study

(and these tolerances should be indicated when the time study summary is written and presented to interested parties).

SALABLE. Anything can be sold--if you spend enough time and money in promoting its sale. Salable standards as used in this paper means work standards that are set and sold within reasonable time and expense limits---standards that are accepted by foremen, operators, and union stewards after a brief explanation of their derivation.

TABULAR. Tabular as used in this paper means any or all of the predetermined elemental time systems now in use: Methods Time Measurement (MTM); Motion Time Analysis (MTA); Work Factor; Basic Motion Time Study (BMT); and others which have been developed by companies and consulting firms. A tabular system of time values for minute body-member motions gives an experienced analyst predetermined time values for various classes of motions which he assigns to a given task. Like the conventional time study analyst, the tabular analyst must first break the task or job down into elements--very fine elements or therbligs. After a careful analysis of the body-member motions that go into a given job, appropriate predetermined time values are assigned to these body-member motions. These are then added together as in conventional time study; the result is the cycle time. The very careful analyst will indicate what the tolerances are on elemental as well as cyclical times.

STANDARD. There are several kinds of standards in work measurement. The most common type of standard is a work standard expressed as so many pieces or units per hour or per day; this is derived after a fair cycle time has been determined and proper allowances deducted from the 60 minute hour. Another type of standard the time study engineer uses is a time standard expressed as so many minutes or decimal minutes per unit of work; thus a time standard of 2 minutes will yield a work standard of something less than 30 units an hour (depending on the net working hour after allowances have been deducted from the 60 minute clock hour). Other standards are allowance standards which vary from industry to industry and from company to company within an industry. Where nothing is said to the contrary, we shall limit our thinking in this paper to work or task standard.

WHY HAVE STOP WATCH TIME STUDY STANDARDS BECOME UNPOPULAR? Although the stop watch is still the most common method of setting work standards today, conventional time study has become unpopular in some quarters for a number of reasons: (1) Unskilled or marginal time study men; (2) pressure of management to turn out a volume of standards; (3) changing labor markets; and (4) changing job designs.

1. MARGINAL TIME STUDY MEN. A marginal time study man is someone who possesses all or most of the following characteristics: (a) Average or below average Intelligence Quotient. (b) High school education or less. (c) Little or no time study training or experience. (d) Just an average amount of objectivity. (e) Average emotional stability. Here, then, are the perfect ingredients for time study failure. Unfortunately the failure of a standards program under these circumstances is usually blamed on the time study personnel or on conventional stop watch time study; the real blame, of course, should be placed squarely on the shoulders of management.

2. VOLUME OF STANDARDS. Because of the costly nature of setting work standards, management is usually reluctant to spend any money on better and less troublesome standards. Failure to turn out a high volume of standards is frequently caused by two factors: (a) Management's failure to realize you can't have both accuracy and speed in the same package; and (b) the time study man's failure to equip himself with modern statistical tools and short cuts.

3. CHANGING LABOR MARKETS. During tight labor markets (and frozen wages) such as obtained in World War II, management compromises work standards programs (and time

study engineers) by encouraging loose standards so that the work force will be happier by earning more money than perhaps the Wage Stabilization Board has permitted. When the labor market becomes normal again or very fluid the reverse psychology develops; attention is once more focused on a "fair day's work."

Unfortunately the scape goat of an incongruous or loose standards program initiated and encouraged during a wartime economy is "time study" or the industrial engineering department. A more objective view would not place the blame on anyone except the common enemy--Germany, Japan, or Russia. During wartime the main consideration is to get the stuff out through the shipping door in order to meet urgent battlefield needs. Moreover, costs are of little concern to companies during a wartime economy due to the excessive tax levies which frequently penalize operating efficiency.

4. CHANGING JOB DESIGNS. One of the chief causes of incentive creepage today is the week-to-week incremental changes in job design without anyone realizing just what is happening. Foremen and operators are guilty of effecting changes in job designs after work standards are established--without reporting these changes. If the pressure is great to establish standards on new jobs "as is", these design changes usually result in an incongruous work load and piece rate structure. Unfortunately when checks are made on "loose" jobs, original and current job design features cannot be easily compared due to the meager information on such items as tooling, materials, work place arrangement, auxiliary materials, machine speeds, machine condition, scrap figures, material handling, and actual job content (especially the irregular elements). Changes in any of these can throw time study standards out of line and cause either management or operators to be unhappy. Unfortunately seldom do these changes occur in opposite directions so as to neutralize one another.

These four reasons (and others not mentioned here) explain why stop watch standards have become unpopular in some quarters. Failure to recognize these reasons has caused some companies to abandon conventional time study and take up something else--only to be disappointed, again. Indeed, one of the main contributions the tabular school of industrial engineers has made to scientific management is their insistance that management gets its technical house in order first before attempting any measurement program. One of these tabular firms even goes so far as to give engineers psychological and other tests to determine whether they have the ability to analyse detailed and complex production problems. Another firm guards its formulas and chart values with extreme secrecy so that untrained analysts will not cause more damage than good when using its data. In short, many of these tabular consulting engineering firms are forcing companies and time study engineers to do what they should have done long ago--select and train the right kind of standards engineers.

HOW CAN THE QUALITY OF STOP WATCH STANDARDS BE IMPROVED? Stop watch work standards can be improved and brought up to the same respectable plane as some of the better tabular systems by taking courageous action in the directions indicated previously. If the incumbent engineers need more training, such training should be taken--either on their own initiative or company inspired. If the standards program is beyond the repair of the company industrial engineers, either replace them with a new staff or call in professional help until the condition becomes better. Just what course of action should be taken under extreme conditions is best judged after an industrial engineering audit has been made.

Specifically, sound and imaginary objections to current time study procedures should be removed by following many rules of common sense. If the soundness of time study standards cannot be immediately demonstrated, more attention should be given to the

reasons why they cannot. If these standards are a product of standard data, it may be that the elemental descriptions are inadequate especially the starting and ending points of the elements; thus it is difficult for anyone not connected with the original standard data installation to select with certainty the proper time values to fit new job designs.

A good time study engineer will observe the following rules of common sense: (1) He will carefully define all the elements in his time study--including body members used, distances travelled, and the starting and ending points of each element. (2) He will include all pertinent data (machine speeds, coolants used, brand and serial number of machine, accessory cutting tools, and quality standards). (3) He will keep all interested parties informed of what he is doing--and why. (4) He will make running checks on his work so that final results may be referred back to known bench marks. The observance of these rules of common sense or engineering prudence will yield surprisingly satisfactory results as illustrated in the following case.

WHAT'S A FAIR DAY'S WORK--A CASE STUDY INVOLVING STOP WATCH TIME STUDY. Several months ago a superintendent called me to give him my honest opinion on what constituted a fair day's work on an assembly line packaging operation. For years the 10 operators involved had been turning out packages at the rate of 130 an hour. The superintendent (new on the job) had made some rough calculations and estimated this packaging group should turn out 160 packages an hour. The operators and the union officers refused to budge from this established plateau of 130 an hour. The job was a day work operation--not piece work. It was pretty well designed so that no job improvements were readily apparent without involving some major equipment development.

When the superintendent told his operators and union officers that he was bringing in an outside point of view they told him he could bring in anyone he wished. But regardless of what this outsider or anyone else said, the figure would still be 130 an hour the same as it had been for years. When I arrived the superintendent tole me he had granted permission to have the union president with me during my time study observations. After some preliminary discussion, all of us headed for the packing room. No one seemed to want to take the initiative so I call the group together and introduced myself and said: "I am here to help all of us arrive at a common understanding of what is a fair day's work on this job. I'll be here all day today and perhaps tomorrow. Your president will be here with me all the time; I'll try to answer all of his questions as the time study proceeds or before I leave. Now I want all of you to work along at your usual pace--neither fast nor slow. When you want to go for a drink or take a rest, don't ask me for permission--go ahead and do it; I plan to keep track of all your time and how you spend it. Now go back to work and your president and I will carry on from here."

I mounted my time study board with two watches and explained to the president that I always use two watches. One watch I use for snap-back or elemental readings and the other for batch or continuous readings; the sum of my snap-back or elemental readings would have to equal the proportional part of the batch or continuous readings (minus personal and other deductions). I asked for help in breaking the job down into its elements starting first with the regular elements and then listing the irregular elements. In fact at this point I served pretty much as a stenographer taking down notes. But before starting my timing I checked with the foreman to make sure that I had not missed any elements or included any that should not be present. Then I started my timing. I timed these operators all the remainder of that day and all of the following day. During this time I not only gathered data but became acquainted with the union president (who was not half as bad an actor as

the superintendent had pictured him to me). I answered many of the union president's questions; and he answered many of my questions.

At the end of the second day I left the plant and worked up my data in my office where I had bench mark data and other facilities not found locally. Because of the large number of variables in this job it took me better than a day to work up standards, curves, and formulas for the various sizes of packages I had observed during my two days of time study observation. Instead, however, of coming up with the superintendent's figure of 160 per hour for the most common package I came out with a figure of 187 units per hour--just 17 per cent higher. Because this figure was so far out of line with either the historical figure or the one the superintendent was willing to settle for, the superintendent asked me to come in and sell my figure to the Union. I agreed to this request.

After the union president came into the superintendent's office I asked him two questions: "1. How many hours of work do you expect your people to perform for 8 hours of pay? 2. Did you think the 10 packers were working unusually fast or unusually slow the two days we observed them?"

The president's answer to the first question was 8 hours: "I don't want anything for nothing; if my people get 8 hours of pay, they should put in 8 hours of work." I then suggested that the company with their personal and other allowances was only asking his people to work 7½ hours for 8 hours of pay. His reply was: "Fair enough." In answer to the effort question the president said: "I thought my people were putting forth pretty good effort--giving a fair day's work." I agreed and told him I gave the group a 100 per cent rating. I then went over the elemental job content and asked if there were any elements which we had omitted. He thought of one. I asked him how often this occurred and he said once or twice a week and at times would last as long as 5 minutes. I said suppose we allow 10 minutes per week for this extra element. "This will then change our final results by something like 0.40 of one per cent."

Next I went over the time values that had been assigned to each element. I showed him where these time values came from--the original observation sheets which he had observed me developing. I showed him how we arrived at the time for all of the regular elements. Then I proceeded to show him how we arrived at the pro-rated time for the irregular elements by dividing the selected times for these elements by their observed or estimated frequency. Then I told him the company did not expect operators to work a full 60 minutes out of every hour in the day even though they were paying $1.50 an hour or 2½ cents a minute for the time of these operators. I asked him how much time he thought these people required for personal needs and a bit of relaxation. He replied about 10 to 15 minutes in the morning and an equal amount in the afternoon. I said suppose we strike an average between 10 and 15 minutes and call it 24 minutes a day which I pointed out was equal to 5 per cent of the working day.

Next I asked how much time these packers would need for preparation and clean-up. He said they would not need much time, if any, for preparation; but he thought they should have around 3 to 5 minutes for some cleaning up around the work place and perhaps a trip to the wash room. I said if we allow 5 minutes for this, the total allowances would then be 6 per cent for the day; thus the net working hour would become 56.4 minutes instead of 60 minutes. "To get the hourly production rate we then divide the total cycle time (the summation of all the regular and the pro-rated irregular elements) into 56.4 minutes. This quotient is 187 an hour for the most common size of package." This explanation took about an hour. Ten more minutes were consumed in providing check figures on this elemental time study figure. I pointed out that so far we have considered only the elemental times as provided by

one of the two watches used during the two days of time study. Now let us see what the continuous watch for several batches of 100 indicates. After subtracting from the total continuous times the various non-working periods (getting a drink, etc.), this time showed the operators were actually turning out packages at the rate of 200 an hour.

After 70 minutes of this careful eye-to-eye explanation, the union president finally said: "I'm convinced. But how am I going to sell this to my people?" I reminded him that he was very unconvinced before we started the explanation; apparently though the figures and a detailed explanation of these figures now leaves him convinced. Would not a similar explanation to his people have the same effect? I told him if he was unwilling to assume the responsibility for such an explanation, I'd be willing to do this for him.

This case is related in considerable detail for several reasons. Chief among these reasons is to show what is possible when step by step and eye-to-eye analysis is undertaken. Note throughout the expert approach was cast aside for the teacher-learner approach. Observe, too, that check data was available at the end to strengthen the validity of the detailed elemental data.

STOP WATCH TIME STUDY VS. TABULAR SYSTEMS IN ARBITRATION. Because of the controversial nature of rating in conventional time study one would think that the elimination of this variable would make for stronger arbitration cases. And a court of arbitration is one of the best testing grounds for any system.

The writer knows of no work standards case that has been won mainly on the basis of tabular values. On the other hand he knows of several cases that have been sustained on the basis of conventional stop watch standards.

There are, of course, several reasons for this arbitration score board. (1) Many of these tabular systems are so new that time has not permitted as many of them to be tested in arbitration as conventional time study. (2) Only a small percentage of arbitration cases are published or made available to outside parties; so the writer's appraisal of this is based on but a few cases published by the Bureau of National Affairs and the arbitration cases that have come before him as an arbitrator.

Those few tabular systems that have stood up in arbitration have usually had other supporting evidence (historical comparisons, movies, or current production records). In these cases it was the movies or other evidence that supported the standards claims. I do not wish to imply from this that time study standards always stand on their own in courts of arbitration. But the arbitration score board to date favors the conventional stop watch time study results much more than it does any or all of the tabular systems.

CONCLUSIONS. We started out to prove that stop watch time study standards can be as accurate and salable as tabular standards. Although somewhat critical of tabular systems, the writer does not wish to detract from these systems. My main plea is <u>not</u> for a return to stop watch standards per se. My main plea today is an appeal to management and industrial engineers to re-focus their attention on the fundamentals of sound industrial engineering instead of desperately grasping for a magic wand that will eliminate or minimize their industrial engineering troubles.

No system, however sound, will ever be a substitute for high grade and well trained industrial engineers. Too many firms have found through bitter experience that tabular systems have done little for them without fully realizing that the systems

were not the real fault; the real cause of failure was bound up with the inherent weaknesses in the industrial engineering or management structure to begin with. No system of work standards--including conventional stop watch and standard data--will ever take the place of common sense and intelligence, education and training in engineering fundamentals, high objectivity, and above average emotional stability and personality.

In short, with a good start of high grade industrial engineers, your system of standards will operate with a minimum amount of trouble and expense regardless of what system you have. But without a corps of well qualified engineers, even the best system will cause you no end of trouble and expense.

MR. KALBACH: Thank you Mr. Nissley. Your promotion to speaker has ended. You may now return to your job as our excellent projectionist. The next speaker will carry our thinking into a synthetic system of time study. As a chemical company employee, my first impression of the letters "DMT" was Diamethical Mytholate, which happens to be one of the ingredients from which we make one of our synthetic fibers, and one which is going to be used as a base for a new film, so the dimensional that goes into synthetic may make us have something in common. I am not going to attempt to explain DMT to you, that is Mr. Geppingers job, other than to say that as I understand it, it is a newly devised synthetic time value system. With pleasure I introduce to you, Mr. H. C. Geppinger(*).

MR. GEPPINGER(*): Mr. Chairman, Gentlemen: - Before going into any details of this new system which we developed recently, I would like to point out to you at first, that I am very much interested, and have always been a very firm believer of common time study procedures. It has been my experience that common time study procedures can give very satisfactory results if the time study man will adhere to sound practices in observing, recording and analysing the elements of the study and the related readings of the watch. Yet I also believe that predetermined time systems are here to stay. They present perhaps, the progress that has been made in the field of work measurements, and have proven perhaps more effective in some particular application than time study. The important factor disclosed in the use of these pre-determined time systems is the adherent ability of a system that allows us to detail manufacturing methods. This factor of course, contributes greatly to the improvement of methods, and it makes it possible to establish perhaps the most economical method, therefore a motion system which permits detailing of methods to such a degree, will not only insure sounder production methods, and standards, but it will also justify the revisions of standards. And it is from this point of view that we have decided to approach this problem of work measurements, which I am going to discuss by means of this system here.

The importance of improving and standardizing manufacturing methods has been given more and more recognition with the development of motion time systems.

Fundamentally, there has not beer any significantchange between these modern systems and the ORIGINAL motion study concept known in industry for many years. This concept still governs and specifies work methods, but the motions under the new systems have been refined, are more concisely expressed, and most important, have assumed a DYNAMIC character since measurement of the motions has become a reality.

The greatest benefit and the one most frequently claimed by the users of these modern motion systems is the inherent ability by which manufacturing methods can be

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detailed. This factor contributes greatly to methods improvements and makes it possible to determine the most economical method. Conventional time study procedures have failed in this respect since methods descriptions usually do not contain enough factual data and refinement so that changes in methods can be recognized and accounted for. Therefore, in replacing time study by some other technique, such as a motion system, it is essential to examine the nature and the motion terms of the system by which detailing of methods can be accomplished. This function of systems is of particular importance when they are used in the establishment of production standards and for revisions of standards. It is primarily from this point of view that it was decided to approach work measurement from the standpoint of dimensional relationships.

We began by conducting laboratory experiments with a large variety of factory parts. Great pains were taken to classify parts similar in size and shape, but it was impossible to obtain groups of parts that varied only by one single dimension. As a result, the information obtained from these tests did not give conclusive evidence regarding time and size relationship and it became necessary to abandon the use of factory parts at this stage of the project.

Failing in this approach, a number of systematic laboratory tests were made with five common washers uniform in thickness, but different in diameters. These tests gave the first indication of a progressive time trend when the data was plotted on graph paper. By glueing 2, 3 and 4 of these washers together, a very pronounced trend was also revealed with respect to thickness. The purpose of these tests was to find a common yardstick for grasping. Other experiments, involving the assembly of these washers to pins of varying sizes, furnished dimensional data on positioning.

The results of these early experiments very definitely confirmed our belief that grasping and positioning motions might be expressed by dimensions. These findings greatly encouraged us to continue this dimensional approach on all other motions and finally resulted in a system of measurement that substitutes dimensional designations for descriptive terms to a large extent. Important steps of this system, which has been labeled "DMT" are outlined in the following presentation.

MAIN OBJECTIVE. The main objective of this research project was to provide the analyst with a Better Tool for selecting time values for grasping and positioning, be relating the times of these motions to such precise terms as Diameter, thickness, target dimension, and clearance, such as noted in Figure 1. (Page 42).

The possibility of expressing time values by dimensional relationships also was tested for transports, which are governed by distance, and for all other motions. When such relationships were not disclosed it became necessary to resort to descriptive terms. "Release" is one of the motions defined in this manner. The results of these early experiments are shown graphically in Figure 2. (Page 42). The work element, consisting of assembling a number of washers to specified pins includes the motions: TE (Transport Empty - to tray); G (Grasp - washer from tray); TL (Transport Loaded - to pin); P (Position - to pin); RL (Release - washer).

Dimensional features, which are necessary for determining motion times under the D.M.T. system, are shown on the chart. These dimensions are uniform with respect to distance, thickness, and clearance, but show different dimensions for washer diameters. By selecting D.M.T. times appropriate with these dimensions the assembly time of each of these washers was established and plotted on the graph. (Curve (X) represents the time trend for this system showing a low time of .020 min. for the $2\frac{1}{2}$" diameter washer and high time of approximately .035 min. for the 5/32" diameter washer.

The other curves on this chart marked I, II, and III represent the time trends of 3 other systems applied to this washer group. The "INCOMPLETE" and the "COMPLETE" curve II, which pertain to one and the same system, but differ greatly in time and trend, give evidence of the problems involved when a system depends largely on descriptive terms.

GRASPING FROM TRAYS. The condition of grasping considered in the foregoing experiment had been specified as "BULK GRASP" or as "JUMBLED IN TRAY". Other supply conditions also are frequently used in industry. These conditions have been classified as "SCATTERED" and as "ISOLATED".

In order to specify grasping for these 3 supply conditions, a great number of tests were then conducted with many pre-fabricated parts to determine accurately the relationship between a grasping time and part size. This relationship is examplified in Figure 3. (Page 42) showing grasping times for six similar parts, when taken from trays, as a time Ratio. By designating the base value of 1.00 as the time for grasping the largest "JUMBLED" object, the time ratios for the smaller parts in this group were determined.

A more complete picture of the results of these tests is contained in Figure 4. (Page 42) which shows a family of grasping curves for ROD TYPE parts. Three of the curves of the Rod Type family have been reproduced on this graph, indicating diameters of 1/8", 9/32" and 1.0". The "Length" or "Thickness" range is shown by the horizontal scale and the time is shown vertically. For "BLOCK TYPE" parts, having a square or rectangular cross-section similar curves were developed. The curve data then was posted in tabular form in order to assure greater uniformity and simplicity of application.

The manner of posting these values for BLOCK type parts is indicated by the table in Figure 5. (Page 42). All table dimensions are shown as "limits" and give "thickness or length" ranges horizontally and "cross-section" ranges vertically. Code numbers and letters have also been assigned to the ranges, by which any selected value should be identified. The parts sketches below the table illustrate the manner of selecting grasping times with respect to dimensions. The "cross-section" of the "FORK" shown as 3/8" x 1/2" would comply with "limits" of 3/8" x 1 1/2" (Code 22). The "length" of the "FORK" being 1 3/4" would refer to the table "limit" of 3.0" (Code H). Therefore, grasping this part at random from a tray would be specified by J22H = 54 OR .0054 Min.

The same code number (namely 22) specifies the cross-section for the "Sleeve", but since its length is only 3/4", which is the limit in column "F", the grasping time would be selected as J22F = 61. The "Blade" is identified by the "cross-section" of 9/64" x 1 1/4" and a "Thickness" of .012". These dimensions are limited by the table ranges of 9/64" x 1.5" (Code 15) and .015" (Code A) respectively. Hence the grasping time of this part would be denoted by J15A = 127. The circled times and the arrows on the chart illustrate the selection of values for these parts.

POSITIONING TO PINS. The determination of dimensional relationships on positioning presented a more complex problem than that encountered in specifying values for grasping. On investigation of the many different cases and modes of positioning disclosed however 3 distinct general groups, which are described as: a. Hole & Pin positioning; b. Positioning to nests of varying shapes; c. Special cases of positioning.

By testing each of these classes systematically it was possible to establish positive time values for a large number of these cases. On "Hole and Pin" positioning for

instance, a time relation was found to exist with respect to the size of the target and the clearance. It was further disclosed that the condition of the contact edges, being either "sharp" or "rounded" influenced the time of positioning. To account for this condition it became necessary to develop separate curves and tables.

The times for this class of positioning are shown by the table in Figure 6. (Page 42) for "sharp" contact edges. The "Clearance" between the parts to be engaged, is noted at the left of the table, and the "Target Opening" appears above the time columns. Each of the ranges are again coded by numbers and by letters, by which positioning times are identified on the methods analysis sheet. Several examples on Figure 6 show how this table is used. The time to position the washer containing a hole .187" in diameter on the .184" diameter pin (case A) is governed by the "clearance", which is .003" and the "Target Opening" which is .187". These dimensions infer to the clearance range (Code 1) of .002" to .004" and the target range (Code H) of .220". Hence the time would be recorded as 84 to .0084 min. and identified by the Code P1H, wherein the letter "P" refers to "Position".

The same washer, if assembled to the .137" diameter pin (Case B), by which a clearance of .050" is provided, would require a positioning time of 50 or .0050 min. The corresponding code for this case would read P3H.

The selection of time values for two-hole positioning is explained by "Case D". The clearance, as the sketch shows is .375" - .365" = .010"; the target opening, namely .375", falls within the range of .440" in the code column "J". Cases of this type require the use of the "Lower" portion of the positioning table, headed "SECOND HOLE", in conjunction with the "top" portion of the table. The case, as pointed out by the arrows and the circled values, reveals positioning as follows: First Hole Positioning = P2J = 52; Second Hole Positioning = P6J = 34; Total Time = 86 OR .0086 min. Positioning tables for square and oblong holes and pins are similar in arrangement to these shown for round holes and pins.

PRE-POSITIONING MOTIONS. In observing an operator perform it is usually quite simple to perceive and interpret Transport, Grasping, Positioning and Release motions. Very few factory operations can, however, be accomplished by this simple sequence, but are usually accompanied by a number of other motions which are not as readily perceived because they occur too quickly and frequently overlap with one or more of the major motions. These secondary motions serve to orient an object of distinct design with respect to the design of the counter part or the fixture. Loosely termed "Pre-positioning these motions, always present a <u>most perplexing problem</u> to the analyst, unless they are clearly classified, defined, and explained.

Under the D.M.T. system these pre-positioning motions have specifically and separately been covered for two main reasons; namely, 1. to set a fair standard with respect to the nature and the design of parts and fixtures, which may or may not require such motions; 2. to permit revisions of standards, either up or down, depending on the efforts by design and methods engineers in improving quality or work methods through re-design. Some of the terms by which DMT specifies such motions are: Turn part Right Side Up (RSU); Rotate part to fit in slot (ROT); Move part to seat (T); Manipulate part between fingers (DT); Grasp specified portion of part (SG). The need for these motions can usually be determined by examining the shape and the design of the part and the fixture. Component parts of a CORE ASSEMBLY, as shown in Figure 7 (Page 42) illustrate this point.

The "Tube", the "base Plate", and the "Core" are to be positioned on the fixture "Post". The DMT motions required for assembling these parts, which are contained in trays are identified by the design of the parts and occur in the sequence shown

by the table below the sketches. The "Tube" for instance, necessitates orientation for positioning the flange downward. This pre-positioning motion is normally accomplished by a "Directional Turn" (DT) and the element would then contain the motions specified in the column headed "Wrong". A more economical method is shown in the column headed "Right". It results in a lower element time because the orientation of the "Flange down" when accomplished as part of "Grasp" replaces the time consuming "DT" motion. The design of the "Tube" having a flange at one end, permits "SELECTIVE GRASP" away from the flange, and presents the type of design, for which "SG" has been established. The "Base Plate", lying usually flat in the tray, does not have this design advantage and therefore requires manipulation or "DT" following the transport. The cross (X) on this plate denotes the side to be placed upwards and therefore justifies additional orientation known as "Right Side Up" or (RSU).

The tubular "Core" also makes it essential to use the "DT" motion before positioning, because the location of the single notch, which must be placed to the rear, is not apparent until the "Core" has been moved near the fixture. Hence the positioning of the "Core" on the "Tube" must be preceded by manipulation, known as "DT". The motions by which these elements are specified show how they are affected by features of part design and give evidence of the inherent nature of the system in accounting for improvements through re-design.

METHODS ANALYSIS - DMT. Since detailing of production jobs by means of DMT depends largely on part dimension it is necessary to show component parts of an assembly directly on the analysis sheet. The form designed for this purpose is illustrated - Figure 8. (Page 43). It provides spaces for job identification, work arrangement, part sketches, and motion details. The columns for recording these details are headed L.H., Code, and Time. These headings are repeated for the R.H. Numbers at the left indicate the motion sequence and a margin at the extreme left of the form is used for part sketches.

The operation "MAKE UP CORE ON ARBOR PRESS" illustrates plainly how this form is used. The layout portrays the arrangement of part trays at the arbor press with appropriate transport distances and other relevant facts. The part sketches appear at the left margin in the order of assembly. These facts and familiarity with job requirements, usually furnish the necessary information for analysing the operation. To facilitate the study and to permit easy reference to specific groups of motions the recording should be made by elements and each elemental group should be headed by a clear elemental description. The motions should now be determined and recorded for L.H. and R.H. and terminate with the last motion implied by the description of the element. Then the DMT tables are consulted to determine and to insert codes and time values. The motions are then checked, non-chargeable times are circled, and the remaining times are added and summarized as an elemental value. The example illustrates this procedure of analysis for the first two elements of the operation. The arrows in the middle of the sheet segregate "directed" from "instinctive" motions, by which manual coordination under DMT is governed.

Dimensional features, such as distance, part size, clearance, and degrees of rotation positively identify the time values for these motions except for releases which relate to descriptive definitions. The latter motions, as well as some special cases of pre-position and position incorporated with the system, for which dimensional relationship were not revealed, still require judgment in their application. The example, however, indicates the progress in the motion study field and points to the following major advantages offered by D.M.T. namely: 1. Because D.M.T. motion times are primarily governed by dimensions, the analysis of production methods is greatly simplified and results in more uniformity of application.

2. Because designations by dimensions eliminate step by step judgment, the training time for analysts is greatly reduced. 3. Because the D.M.T. system specifies finite limits of sizes, in progressive order for all major motions, the system inherently accounts for methods changes, so that revisions in standards can actually be reflected and justified.

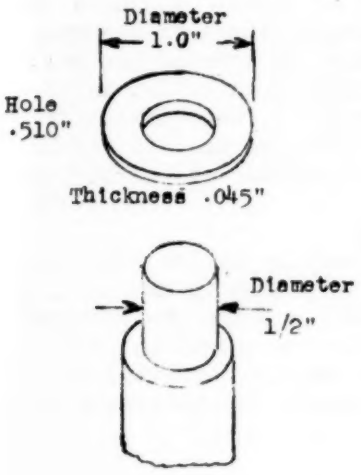


Figure 1.

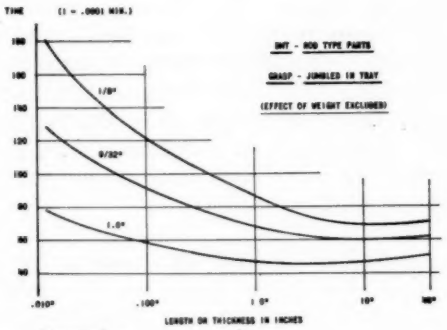


Figure 4.

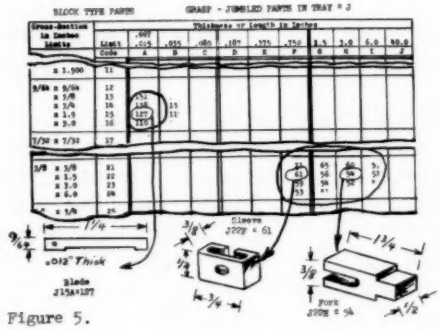


Figure 5.

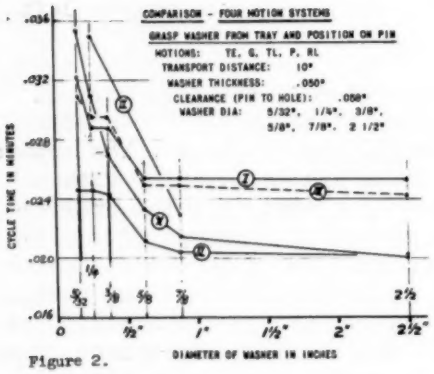

COMPARISON - FOUR MOTION SYSTEMS
GRASP WASHER FROM TRAY AND POSITION ON PIN
MOTIONS: TE, G, TL, P, RL
TRANSPORT DISTANCE: 10"
WASHER THICKNESS: .050"
CLEARANCE (PIN TO HOLE): .050"
WASHER DIA: 5/32", 1/4", 3/8", 5/8", 7/8", 2 1/2"
CYCLE TIME IN MINUTES
DIAMETER OF WASHER IN INCHES

Figure 2.

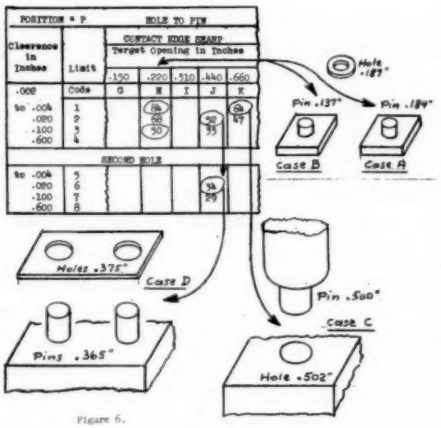


Figure 6.

RATIO OF GRASP TIMES

DIA.	Thickness or Length in Inches .015"	Thickness or Length in Inches 2.0"
1/8"	R=4.03	R=1.75
3/8"	R=2.82	R=1.42
1"	R=1.75	Base = 1.00

Figure 3.

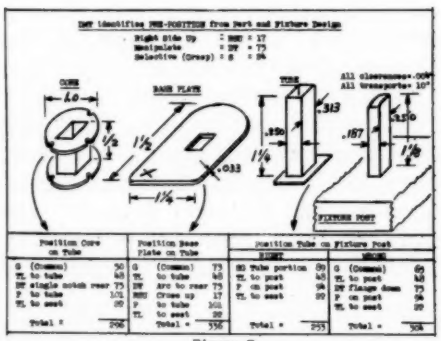
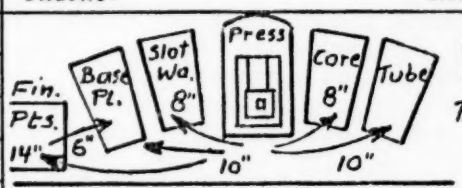


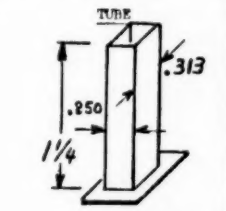
Figure 7.

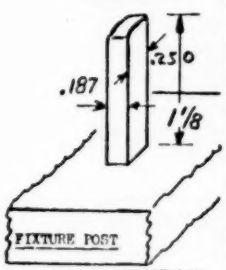
METHODS ANALYSIS - DMT

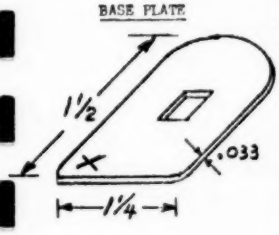
OPERATION Make up Core on Arbor Press	DRG.NO.	CAT.NO.
PART NAME:		
APPARATUS:		

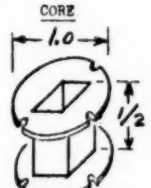


All Clearances = .004"
Fixt. Slide = 2.0"
To Press Handle = 12"









	L.H.	CODE	TIME	TIME	CODE	R.H.
	I. Assm. Tube and Base Plate to Post					
1	TE to Base Plate	T6B	38	(38)	T6B	TE to Tube
2	G " "	J29B	73			
3				89	J21G	SG Tube
4	TL to W.A.	T10B	(48)	48	T10B	TL to Post
5				94	P11B	P on Post
6				16	T1B	TL to Seat
7	Manip. Arc to Rear	DT3	75	(8)	RL2	RL Tube
8	Turn Cross up	RSU	17			
9	TL to Tube	T2B	22			
10	P on "	P11I	101			
11	TL to Seat	T2B	22			
12	RL Plate	RL1	0			
			348 +	247	= 595	
	II. Assm. Core and Slot Washer to Tube					
13	TE to Slot Wa.	T8B	44	(44)	T8B	TE to Core
14	G " "	J41B	71			
15				50	J41F	G Core
16	TL to W.A.	T8B	(44)	44	T8B	TL to Tube
17				75	DT3	Turn Single Notch Rear
18				101	P11I	P on Tube
19				22	T2B	TL to Seat
20	Turn Single Notch Rear	DT3	75	(8)	RL2	RL Core
21	TL to Tube	T2B	22			
22	P on Tube	P11I	101			
23	TL to Seat	T1B	16			
24	RL Slot Wa.	RL2	8			
			337+	292	= 629	
	TOTAL (Carry Forward)					

Figure 8.

MR. KALBACH: Thank you Mr. Geppinger. To the famous three M's -- Men, Material, and Machines we will hear from another dimension of Manufacturing which the next speaker terms as "Quality Control". Mr. J. D. Pill(*) will speak on "The 4th Dimension of Manufacturing.

MR. PILL(*): Thank you Mr. Kalbach, First I want you to review the movie on how quality control and inspection is maintained at our company. In the organization chart you will note that Quality control at our company is headed by a Vice President who in addition to being responsible for Quality Control, he is responsible for Research and Development. The Quality Control Division is subdivided into four sections, namely: Quality Techniques, Home Office Sample Room, Product Display Library and Complaint Handling. All these features are covered in the movie, and in addition a portion of the film covers quality control at work via inspection.

The technological development of modern industry has been a boon to all who live under its influence. It has raised the standard of living through increased productivity, it has increased the nation's prosperity and has made more goods and services available to more people than at any other time in history.

The beneficial results of this technological development, however, have created an exceedingly complex business world. Manufacturing establishments have become highly integrated, diversified organizations and, within the individual corporate enterprise, the functions and responsibilities of research, design, manufacturing, purchasing, finance, distribution, merchandising and marketing demand exacting coordination and control if the company's objectives are to be met. It should come as no surprise then that most of the top business executives are adopting the world "teamwork" as a by-word for success. The manufacturing facility, as a part of the team, has traditionally been characterized by the famous three M's; men, materials, and machines. But a new dimension, a 4th dimension, has been added to the manufacturing process as the precision and speed of industrial production have grown day by day. The 4th Dimension of Manufacturing is not a new concept but it has evolved to a prominent position in our economic sphere, nurtured by the success of other factors of industrial growth. This 4th dimension is the need for properly controlled production on a quality basis.

Quality is a nebulous phenomenon in many respects. Every company wants its products to achieve a reputation for quality and millions of dollars are sent forth each year to build quality into a product and to bring this quality to the attention of the consumer. But what is quality? Concepts differ, but it might mean any of the following: 1. Workmanship; 2. Functionalism - the ability to perform; 3. The luxury look - the absence of cheapness; 4. Uniformity; 5. Reliability; 6. Design; 7. Life of the product; 8. Appearance or Finish.

It is probably safe to assume that the top management of every company demands the production of goods of the highest quality within the limits of what they can afford to spend. Diversification of products and the introduction of complete lines makes of paramount importance the requirement that every product of the line be of the highest quality. The growth of institutional advertising as compared to brand advertising associates the company name with all the company products and the customer good will built up over the years can be quickly dissipated by the distribution and sale of a single poor quality product. This is just one of the reasons why market research, sales testing and consumer testing are developing into such important parts of the overall business picture. In the mass consumer goods industry

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(*) Chief Industrial Engineer, Colgate-Palmolive Co., Jersey City, New Jersey

strong promotion programs and aggressive selling can fill the pipelines and get the goods on the shelves and ultimately into the hands of the consumer, but from then on the product is on its own and repeat sales, the only true measure of quality and value, tell the story of success or failure. In spite of any past success, however, the concept of quality must be dynamic lest complacency or self-satisfaction play into the hands of the competitor. Top management recognizes the importance of this check-valve aspect of product quality - never let it slip back, never allow it to be compromised, constantly seek to improve the quality position.

It has often been said facetiously of sales organizations that, when sales are good and quotas are met, they proclaim their ability to sell but, as soon as their programs falter and sales dip, they complain that the product quality is so poor that no one could sell the product. However, mass consumer goods are always sold against strong competition, supported by aggressive merchandising. For the most part, sales prices are comparable, the packages or containers are attractive and, with going concerns, the performance of the products is similar. Everything else being equal, the product with superior quality characteristics should dominate the field. This means that quality must be built into the product, consistently and uniformly. It is not difficult to visualize the frustrations involved in attempting to sell an inferior product in a highly competitive market. The effect on the profits of the company of such a venture is equally as obvious. Manufacturing people may never have to sell the products they make but, if there is insufficient profit contribution department by department, there can be nothing in the future of the company but impending disaster for all. Little wonder that such slogans as "Quality is Everybody's Business" have been developed by various companies throughout the country.

How does a manufacturing department organize to respond to this 4th Dimension? Who decides on how much quality goes into a product? How much money and how much time can a company afford to spend on quality control? What factors affect quality control and what are the pitfalls to be avoided? These are all questions that require decisions and policies. Here is how the Colgate-Palmolive Company approaches these problems:

The Quality Control Division (Home Office) consists of four groups, (1) Quality Techniques, (2) Home Office Sample Room, (3) Product Display Room, and (4) Complaint Handling. This division spends full time on the quality of Colgate-Palmolive products and evaluations and comparisons with competitive products. The Quality Techniques group is responsible for establishment of sampling plans, inspection frequency and procedures covering raw materials, in-process materials and finished goods. This phase of quality control requires considerable ground-work and preliminary analyses before firm recommendations can be made. This group also participates, on a staff basis, in the development of design characteristics of specialized testing or sampling equipment.

The Home Office Sample Room displays representative samples of finished goods from all plants for specified periods. Finished goods are received weekly, appropriately coded for time and location of manufacture, and are available for inspection by interested activities. The Product Display Room compares Colgate-Palmolive production of the major brands with that of competitors. Packages and containers are opened for inspection and data relative to filling weights, color and other pertinent properties are posted on blackboards to show how all the products compare. The Complaint Handling group handles complaints and works in conjunction with the Legal Department and the Research and Manufacturing departments as is appropriate.

Formulation is performed by the Research and Development Department in much the same manner that design is performed by Design and Engineering Departments in the

metal working industry. Chemical analysis of competitive products is also performed by analytical groups in the Research and Development Department. Upon completion of the sampling and testing program, Standard Practice Instructions for all plants are developed by the Standards Division and are subsequently approved by the Manufacturing and Research Departments. Auditors visit the plants periodically to check on performance of the plants in conforming to the Standard Practice Instructions.

The Control Laboratories in the four domestic plants are divided into two groups, the Analytical Laboratory and the Quality Control and Packaging Materials Inspection Section. The analytical group is concerned primarily with analysis of incoming raw and base materials, in-process materials and the chemical characteristics of finished goods. The quality control section inspects incoming packing materials and is organized on a statistical quality control basis to examine the physical properties of finished goods. Statistical quality control functions are carried out on all operating shifts, depending on products covered, the control work being performed within the production department. The presence of quality control inspectors within the production departments does not affect the responsibility of the foreman for product quality. Quality performance is a responsibility of line supervision. The inspector is a staff man whose duty is to inform and advise the foreman without assuming any of the foreman's prerogatives.

It is most interesting to note that a substantial reduction in costs resulted from the establishment of statistical quality control in the production areas in which large volume items are manufactured. In the past, operators and foremen tended to overfill packages and containers above the tolerances specified. On the operator reports, which they made out, the weights reported appeared acceptable although field pick-ups revealed overfilling. Since the operating reports were used for accounting purposes, the accounts would show nominal overfilling as reported by operators and foremen, plus unknown in-process losses. Since the physical system is complex and variables are inherent in sample taking, testing, yields, moistures and densities, pin-pointing the loss was most difficult. In view of this problem, it was decided to have the quality control inspector make up the filling weight report, weights being taken at least 4 times per hour, in the hope of obtaining a more objective and accurate report. The experience since has been most satisfactory and the savings in elimination of overfilling have amounted to many thousands of dollars. The potential saving in materials in a mass consumer goods industry is, of course, tremendous. Even small amounts of material, when multiplied by large volumes, are significant. As an example, a reduction in average filling weight of 1/8 oz. per carton of the product Fab, which was shown in the movie, amounts to a saving of $115,000 per year at current production levels. It is essential, therefore, that every attempt be made to take advantage of the cost savings possibilities in conjunction with the quality control program. At Colgate-Palmolive, the reduction of losses as a by-product of quality control has more than paid for the expense of the statistical quality control function.

Multi-plant operations pose problems in the control of quality, primarily due to different concepts of quality plant by plant. Many of the desired quality characteristics can be uniformly determined by the issuance of universal color standards, specified densities, moistures, etc., but the manner in which a carton is glued, a can is seamed or a tube is crimped is left somewhat to local interpretation. A good measure of control is achieved by travelling auditors and production executives and the submission of samples to the Home Office to keep quality uniform throughout the country. So much for Colgate-Palmolive. Every company can adopt a policy of "Maximum Quality - Minimum Cost". Not only should the finished products be of the highest quality but the production should be controlled so that there are fewer defects as the production process progresses, less scrap and waste should be

produced, and fewer returns should be received from the trade. Not to be overlooked in any industry is good housekeeping. Neatness, orderliness, and cleanliness are requisites in a quality minded manufacturing establishment. Sloppiness in the work place results in sloppiness in the work performed.

Industrial experience has shown that the human element in inspection work is often unreliable and particularly so when it is difficult or impossible to assign responsibility to the employee for sub-standard quality. As long as the human element is a factor in any phase of business activity there will be mistakes. The objective, of course, is to reduce the influence of the human element insofar as possible. In inspection work, and many industries have inspectors within their line production operations reporting to manufacturing departments as well as to inspection groups, the jobs often become monotonous and boring. This tends to induce day dreaming and in some instances a rubber stamp or within the tolerance attitude towards all production be it good or bad. Successful manufacturers of quality products will inevitably come to the installation of more and more mechanical means of inspecting goods using equipment such as automatic ejectors, printed recording tapes and automatic sampling devices.

There has been concern from some quarters that production incentives are conducive to lowered quality. Incentives are paid on the basis of plus money for plus production and this implies production of acceptable quality. A company with a sound incentive program will not pay a premium for producing scrap, rejects or poor quality goods. Actually, as employees develop the skill, rhythm and dexterity in performing a job and incentive production levels are reached, the plus money to which they are entitled comes not so much from harder work as it possibly does from smarter work. Once these levels of performance are achieved and maintained, the consistency and uniformity of quality production are assured. It has been demonstrated time and time again that incentive operations are conducive, rather than detrimental, to controlled quality production.

One of the dangers inherent in extending the influence of the 4th Dimension of Manufacturing is in the concept, by the employee and supervision, of the relationship of price and quality. If a silk shirt costs $10 and a cotton shirt $5, the fact that the silk shirt has been developed to meet a particular segment of the trade and cotton another should not affect the production controlled quality of either. Reverting to the discussion previously of the trend towards complete lines, every item in the line should conform to the quality characteristics established for that item. There is an old story about the cotton farmer who refused to buy a book on scientific cotton farming because, as he said, "Heck, I don't farm half as good as I know how now". This is the attitude that needs considerable attention from manufacturing executives. There are many people at various levels of manufacturing organizations who are not doing "half as good as they know how" on lower priced mass consumer goods. A responsible, reliable company cannot afford a "let the buyer beware" attitude on the part of its employees and it is essential that quality mindedness be generated throughout every level of the organization.

Recently a new term has reached the mass production industry - AUTOMATION. Most of the publicity concerning automation has been centered around the automobile and appliance industries. The most significant thing about automation is that precision, electronically controlled machines can make precision products at high rates of speed with a minimum labor requirement. Needless to say, properly controlled, quality production requires good, well maintained equipment. However, in view of the large capital expenditures involved in providing new equipment, wholesale turnovers of equipment for quality reasons are often impossible for reasons of economy. Statistics show that poor quality is generally confined to relatively few locations or work stations. Since these locations are pointed out emphatically by statistical

quality control methods, it is possible to take appropriate action for correction with minimum expense. Thus it is possible with adequate records to analyze poor quality situations with the view of determining whether further investment in quality is economically sound.

The cost of quality, like every other factor in manufacturing costs, is ultimately measured against the value of that quality to the consumer. Due to the intangibles involved in evaluating the quality from the consumer standpoint, this measurement poses a real problem for industrial management. Many outside factors influence the decisions that have to be made; what competition is doing, what the sales organization wants, what the design or formulation people have in mind and, yes, whether it would be approved by Good Housekeeping or Parent's Magazine. Undoubtedly, fat and luxury exist in design and formulation, some of it as a result of overcaution, some of it built into the product purposely either to meet or exceed competition or to develop a superlative advertising story, and some due to poor analysis of consumer desires. Many millions of dollars have been spent on quality characteristics which fail to impress the consumer at all. A point has been reached, particularly with the successful application of statistical quality control methods, where the analysis and control of quality are accepted as technically accurate although the evaluation of the consumer's concept of this quality is still primitive.

While this is not a manufacturing problem as such, its effect on manufacturing as a part of the team is apparent. Much work is yet needed to provide modern industry with the means to enable it to determine where the break even points are in the measurement of the cost of quality against the value of it.

The post war shortage of goods era has passed. Automobile salesmen are even knocking on doors now to move their quotas. The general availability of goods and services and the battle for the sales dollar have created stiff competition, and industry has come into a "hard to make, hard to sell" stage. In selling, this will mean scientific sales forecasting and planning, competent sales management and aggressive sales organizations. This in itself manifests a provocative challenge to manufacturing executives to do an improved job in production planning, inventory control, production control, cost control and that important 4th dimension of manufacturing, quality control. Gone are the days when maximum production with the best quality and costs that could be mustered was satisfactory. Gone are the days of the excess profits tax and the 18 cent expense dollar. Here are the days to be realistic, to recognize and face the facts that survival and success follow the controlled production of fundamentally better products, with maximum quality, minimum costs.

SECOND SESSION CRITIQUE: Theme--"New Industrial Engineering Principles"

MR. KALBACH: I have a question for Mr. Nissley. First of all, "In selling stop watch time study, how do you overcome the argument that the time study man's rating of performance is based on his own judgment, which may be called faulty?" and "Is not unscientific rating procedure the real weakness in stopwatch time study?"

MR. NISSLEY: Well, of course, that is one of the weaknesses in stopwatch time study. I might say that I have been fortunate in my own time study work in getting agreement among the interested parties. If I think I am running into trouble, I try to get various points of view; I will call the Union steward and the foremen and get them to agree on a 100 per cent (or average) operator, if possible. I tell them, of course, that I don't intend to be bound by this mutual agreement. "But I like to see, first, what you and the foreman consider to be an average or 100 per cent

operator." You would be surprised how much easier this "meeting-of-the-minds" approach can make your subsequent standards selling job.

I might say further this whole subject of rating is confused because of the time study engineer's lack of appreciation, in many instances, of the learning curve or acquired skill characteristics of a job. A time study engineer may observe an operator going through smooth (but slow) motions; it may be the operator's first day or the first week on the job. The smooth rhythmical work pattern of the operator may cause the engineer to rate the operator higher than his actual speed warrants. The rating error may not be detected until 7½ weeks later when (according to learning curve studies) the operator is producing twice what he produced the first week he was on the job. Unless, therefore, you recognize this acquired skill concept--this incremental dexterity type of phenomenon--your rating, however accurate at the moment of observation, may be off as much as 100 per cent 7½ weeks later. This creeping incremental skill and speed phenomenon is one of the reasons why the tabular or pre-determined time systems have not displaced conventional stop watch time study; a system may be predicated upon acquired or "long-run" skill. But what good does it do to set standards predicated on production runs lasting months when the average run in your own shop lasts but a few hours or days at the most? If anyone is interested in this learning curve phenomenon further, I'll be glad to cite him literature references at the close of this session.

MR. KALBACH: "Another question, Mr. Nissley: "When a job design is changed, what approach do you recommend? (1) Retime the entire job? (2) Retime and change only the elements involved?"

MR. NISSLEY: If you make a change, large or small, you have the moral and legal right to set a new standard and hence new rate on that job. Fortunately for everybody the practice is fast dying out of re-timing an entire job whenever a "loose" standard is discovered and a small change in the job design is made. In other words you re-time only those elements or that part of the job which are changed; and the new piece rate will differ only by the percentage change (time-wise) in job content. Any other position cannot be supported either morally or legally. This point has come up in my own arbitration experience and is one I could discuss at further length at the close of the meeting, if anyone is interested in it.

MR. KALBACH: "I believe in your talk you mentioned the fact that industrial engineers should use modern statistical tools and short-cuts. Would you please indicate the kind of thing you mean?"

MR. NISSLEY: By modern statistical tools I don't mean the highly technical stuff that statisticians are constantly wallowing through. I have in mind some of the ordinary common-sense types of statistical tools: sample comparisons and measures of sample adequacy; median values instead of the old and cumbersome and less reliable arithmetic averages. Median values, for example, can give you more reliable results in just half the time compared with the more common arithmetic averages that over 90 per cent of time study engineers continue to use today. Time will not permit me to discuss some of these more reliable and time-saving tools further. But I have covered them fairly adequately in an article which appeared in MODERN MANAGEMENT, January, 1948--"Time Study Simplified."

MR. KALBACH: This one is for Mr. Geppinger. How does DMT compare with other systems in Accuracy?

MR. GEPPINGER: Since "Accuracy" is said to be improper in the field of work measurement I would like to substitute "Uniformity" and "Consistency". The DMT system, permitting selection of motion times from "blueprint" dimensions, obviously

insures uniformity and consistency at all times. This assurance cannot be expected from systems defining motions largely by descriptive terms because such terms are subject to judgment. An examination of the motion tables, the terms defining the motions and the empirical rules for adjustments of values usually disclose the extent to which judgment is necessary in the selection of motion times.

MR. KALBACH: How does DMT compare with other systems in number of sheets required to analyze a job?

MR. GEPPINGER: Systems like DMT, dealing with "complete motions" in general would require approximately the same number of details and sheets for recording a given job. Some other systems, specifying grasping or positioning on the basis of transports, require various types of adjustments for "completing" these motions. The recording is therefore more lengthy under such systems.

MR. KALBACH: How does DMT compare in time required for analysis?

MR. GEPPINGER: The time to analyze a job depends primarily on how concisely motions are defined. Numbers, such as dimensions on a "blueprint" are factual, simple, and concise. Systems using descriptive definitions, generalities, and rules specifying conditions are governed by opinion and judgment to arrive at decisions. DMT, applied largely from dimensions avoids "decision" time and therefore reduces the time in analysing a given job.

MR. KALBACH: Have you used DMT for setting Incentive Standards? If so, what is the union attitude towards this method?

MR. GEPPINGER: Yes, DMT has been used for establishing incentives. It is also used in planning and methods departments to determine labor costs on new devices in the planning stage and for checking and improving work methods.

The objective of any system is the attainment of more equitable and relatively uniform standards. The acceptance of a system then depends on how well a job has been done, in acquainting employees and union with these basic fundamentals. This was borne out by the union when informed about DMT stating that they are receptive to the system as long as the resulting rates are fair and equitable.

MR. KALBACH: How do the time values which you have discussed here compare with other predetermined time systems?

MR. GEPPINGER: A direct comparison of the time values of the various systems is of no avail, and for many reasons, rather misleading. This is caused chiefly by differences in concepts under which each system was developed. The most severe and possibly most effective test is illustrated graphically by the sample on the first slide. This chart shows the time levels and trends of several systems on the basis of a complete cycle applied to a harmonious, inter-related work element. These time levels give an idea on how these systems compare. The changing trends of the curves show the degree to which the systems respond to physical changes of objects and thereby give a clue regarding flexibility.

MR. KALBACH: Well it looks like we all are going to go home and do a little more reading. Now here is a question for Mr. Pill - "Does your company have a regular inspection organization, as well as quality control?"

MR. PILL: Well, we inspect incoming packing materials and see whether they meet specifications, tubes, cartons, bottles, etc., and all the raw materials are inspected on a formula basis, as they come in to see if they meet the specifications.

Now the statistical quality control people are primarily looking at the physical aspect of the goods produced, either as finished goods or in process. For the items which are produced which are not of significant volume as compared to some of the large movers, those go up to a laboratory, where they are also analyzed in this control laboratory, not by people on the floor but by people in the laboratory.

MR. KALBACH: "What is the background of some of these people you have in this statistical part of this control program?"

MR. PILL: They are people who have had some chemical training, usually in high school. They are not college graduates. We have some trouble in keeping them because they are not technical people as such, and there is some consideration being given to bring in technical people, who in effect could add a lot, and in effect could act as assistant foreman, or assistant supervisors, but there is a line down the middle, as some people say, "well then he gets to be a foreman," and then other people say, "well, we don't want him to be a foreman," but in some instances he may be able to assist in some of the line operations if he were given that permission.

MR. KALBACH: Thank you very much - I think that will wind up the questions.

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THIRD SESSION: Thursday, May 6, 1954, 8:30 A.M.
Theme: "NEW INDUSTRIAL ENGINEERING PRINCIPLES"
Presiding Officer: Dr. K. P. Vinsel, Executive Vice President, Louisville Chamber of Commerce.

DR. VINSEL: Louisville and Kentucky is booming industrially. This conference on "What's New In Industrial Engineering"is very timely and important to our industries here. The first speaker told me his talk will take 25 minutes and his time allotment is 30 minutes, therefore, I will save my remarks for later and introduce to you Mr. J. J. Kaye(*) who will tell us about "MANAGEMENTS' SIXTH SENSE".

MR. KAYE(*) Thank you Dr. Vinsel. I am not going to take longer than the time we have allotted, consequently, I will discuss Budgetary controls from the point of view of the automotive industry. Today the cost of doing business is receiving a great deal of attention. Not only in the automotive and allied industry, but in all businesses who have profit as an objective. Significantly budgetary systems are the tool used to control and forecast costs and profits.

For some time, business magazines have been devoting a great deal of space to articles in which the theme suggests ways and means of improving cost and profit positions. These same publications site examples of drastic matters and reorganizations and changes in their financial structures to meet competition, and vacate unfavorable profit positions. The automotive industry presents perhaps one of the largest investments in American business. A financial venture of this magnitude requires a great deal of management know-how, and foresight to administer those funds wisely. Budgets and budgetary systems are a sound management tool. They provide the guide posts for conducting a business judicially, and for appraising current and future expenditures.

(*) Manager, Manufacturing Standards Department, Ford Motor Co., Detroit Mich.

Budgets are established in the automotive business for all costs, but particularly those which a factory or company can control. Obviously many items of cost are so called purchase items which a vendor or supplier furnishes the car manufacturer. Principally I will confine my remarks to the controllable costs which consists of direct labor, indirect labor and other over-head. The importance of budgets for these cost elements can be appreciated more fully when we review the life span of a typical automobile model. Perhaps you are aware of a car's life span, but I would like to take a minute of your time to review it with you, especially of interest is a fact that a new model announced and unveiled to the public today, is actually three years old. It requires approximately 36 months from the first style renderings (those are the artist sketches of what the new car will look like) thru the various evolutionary stages, to be in a position to start production of a model. During this period of time, the automotive style renderings take more positive shape in the form of a 3/8 and full scale clay model, of exterior surfaces and dimensions. The inside trim markups are simulated, both the clay model and the lock-up progress thru the wood and metal stages during which time die patterns are built, dies are designed and constructed, and after all of this research, design and construction of tooling then finally emerges your new model. It might be of further interest to you to know that during the entire life span of a new model, it is constantly being subjected to an evaluation from the standpoint of customer appeal and particularly cost. As each proposed change is considered by management, thru the evolution of sound design, it is necessary to evaluate the consequences. Every part of the car or truck must be scrutinized from the standpoint of the effect it will have upon material cost, labor and the facilities. In this highly competitive business, a sincere effort is exerted beginning not only at the styling stage, thru the various points of model development, but during the production of the model to maximize what is offered the customer in style and design for the dollar spent. We in the Ford Motor Company believe that this is one of the reasons for the increased customer preference for our products, and believe me that is just not a plug.

The manufacturer and sale of automobiles is not only a styling and design problem, but is also a major financial problem. If you have noticed or tried to compare the styling features and refinements in the car of today in relation to yester-year, you will quickly realize that the car of today has costlier features and appointments. The car manufacturers and particularly the large producers of which we, The Ford Motor Company, is considered a part of, have sponsored and developed techniques and methods which benefit the customer, and at the same time hold the line on cost.

It is extremely important for management to create techniques and measuring devices in order that they may be appraised as to where it has been, what is its position today, where is it going in future months and years.

In the case of the Ford Division which produces over a million cars and trucks in a multi plant arrangements of assembly plants, located from coast to coast, each plant location is considered an independent profit center. Within these plants the work assignments involve some 30,000 operations. I am sure you can appreciate our need for sound and realistic budgets. While the automotive industry has gained widespread fame as a mass-producer, the management difficulties and problems have progressively become more complex. Today a factory is subjected to constantly changing makes of models, particularly since a customers preference is of extreme importance, and this of course is coupled with parts availability. When parts shortages occur, it is necessary that factory Management make on the spot revisions to their schedule. Today we have a far more complicated vehicle to build, since models and car-lines are expanding, and customer reactions are increasing. The standard car of today is produced to any number of customer preferences in color, trim-combinations or a variety of options, such as power steering, power window lifts, power seats and etc.

Today the car manufacturer has many more manufacturing problems than ever before. Yet, these are all recognized as normal situations, and the manufacturer conducts his business in what appears to be a normal manner. Normalcy considers however, that the greater vigilance is exercised thru controls, forecasts, and performance reports which are projected against the financial target. If we are to measure performance it is first necessary to establish realistic and obtainable targets. This requires a sound system of work standards, which indicate the labor task. The standards must be so designed and detailed to give each and every operation visability. Also they must be readily interpreted by all levels within the organization. I would like to tell you something about the technique and approach to the problem that is used in the Ford Division, and I believe logically that we must start with a job in our assembly plant, a typical job in our assembly plant. Incidentally, we use the same approach to our work standards in direct labor, as we do in indirect labor. Also it would be well to mention at this time that we do not have an incentive wage payment system, but use what is normally known as day-work.

We are faced with constantly changing schedules, models and from one year to another time study is tremendously useful, but it is limited due to the changing conditions, wherein it does not lend itself as a control tool, other than its application to the control system. For all practical purposes the work standards are based on time study data. Production standards within the plant are constantly being checked and reviewed by means of the time study technique, and this is related to the work standard. This data is developed for each direct and indirect labor operation performed within a plant.

For example, based on experience and time study, we know that it takes a given number of minutes to unload a box-car of rear-axles or body sides or fenders, and the many other items, using a given method relating the standard to the model-mixing volume. We have in effect developed our indirect labor budget or financial budget. The sum of the direct labor operations, standard times, the number of vehicles of each model type, gives us a plant standard for the day or the week. Using the standard we can compare or evaluate actual plant performance within each one of our plants. In effect we have established a financial standard which can be used for appraising and developing performance, forecasting since our work standard is in terms of minutes we can compare individual job performance against the established standard.

Further, we can compare one plant against the other, in total or by operation. In this way, giving detailed visability to situations requiring corrective action. It might be well at this point to take our attitude towards work standards and their use in our plant. Since the work standards are a very important part of our financial and budgetary planning, to be successful they obviously must receive acceptance at the plant level. When a man or a group of men go on a job, we tell them at that time what their standard is. Frankly we want our people to know what we expect of them. Our objective is to have the people in our plant working as close to an equal task as it is possible. From the standpoint of quality, and engineering specifications, the work standard has a tremendous significance, since it embodies the requirements of the quality standards and the engineering specifications. Also it reflects the use of tools, the location of material and stock, the methods employed and the sequence and arrangements of our operations. This system permits financial evaluation of quality level and engineering specifications levels. For all practical purposes we have what is called a variable direct labor budget, and a variable indirect labor budget. Of course, the indirect labor budget does have a fixed portion which must be on hand irrespective of plant volume. Also we have material standards, and I might mention indirect material standards, now in the process of being established for each direct labor operation. This consists of flies and sandpaper and the various other indirect materials which are used within

our direct labor operations. This also is variable depending upon production volume and type of models being produced.

Management reviews each plant's performance to the established standards by departments. Generally, these reports are prepared indicating the percentage over or under standard for the period. For our purposes we have found this method of reporting sufficiently informative to enable judging the performance. In this way, Management is appraised as to where we have been, and is alerted to the areas requiring corrective action. Planning assumes an important position and role in the automotive industry, due to the frequent changes and schedules and models. The impact that these changes have on facilities, tool and fixture requirements and work allocations, which must be evaluated, work standards for direct and indirect labor, play a key role in planning production to achieve an efficient cost performance. Organizationally work standards also play an important role since thru this media, quality control, product engineering, production engineering, or manufacturing engineering, as we refer to it within Ford Motor. What does all of this conglomeration of work standards and budget development as well as detailed planning mean to you, the purchaser of our Ford cars or trucks? Let me cite several examples - today a typical worker only has to work 29 weeks to buy a Ford car, in relation to 36 weeks in 1939, and 33 weeks in 1949. This is an improvement of 20%. This is a result of mass production, resulting in reduced cost to the customer. The constant search for improved methods and techniques, find in the budgetary control system its expression of positive proof of the direction of research engineering, styling, and manufacturing must take to improve cost positions and increase the value of products, which are delivered to the customer.

Finally - budgets and controls must be tailored to the individual requirements, and then applied enthusiastically and energetically. Work standards in the Ford Division are the foundations for budgets, pricing and financial and profit forecasts. Through their use we are able to give visibility to those situations and conditions requiring the attention of management, thereby contributing further to our knowledge of our business and providing customers at reasonable cost, products that have the style, design and performance they expect. Thank you Gentlemen I have appreciated making this talk.

DR. VINSEL: I can see Mr. Kaye that you know a great deal about accounting and budgeting, for you budgeted your time right on the nose. I was impressed with this talk and with your work, and I cannot help but mention that we have here what is known as the Civic Lecture Series in the High Schools. This year I had the task of speaking to a group of 7th, 8th and 9th grade students on the subject of "Our American Economic Democracy". The thesis was something like this - In our economic system, the consumer runs the business really and calls the tricks, and by voting - while in politics we have elections every year, in most states, and we elect our Mayors and Governors, Presidents, Congressmen and etc. periodically, in economics in our country there is an election going on every day, every hour, every minute and every second. We vote for products by spending our money. Those kids, those youngsters who spend a nickle for a candy bar, what do they do, they spend their nickle for the biggest candy bar and the best candy bar, and when they go to buy a car, if they buy a car, well number one, they can decide whether they are going to buy a car, a refrigerator or a television set, or not, and then they vote for one company, and one product, as against another, and American business is in the squeeze of trying to produce the product that the people want, at the price they want to pay for it. If some company does not do that, if they don't keep on their toes, then you are going to get voted out, which is just the way it should be, and really I think that is the basic theory and the basic principle behind our American Economic Democracy. The people vote on the product, and we don't have any body to tell us what to make, how much to make, how much we have to pay for it, or do we have to

allocate. People can buy what they please. Therefore it is up to business to produce that which gets the most economic or dollar votes.

DR. VINSEL: Our next speaker will cover the field where the consumer stops and manufacturing starts. Mr. John W. Logan will tell us what goes on in early stages of creating a product. His subject is "TRANSITION ENGINEERING AND MANUFACTURING AND ITS APPLICATION TO INDUSTRY", Mr. Logan(*).

MR. LOGAN(*): Thank you Dr. Vinsel, it is nice to be here. I hope the Cambridge Corporation will have an opportunity later to participate in future programs, -- but to business -- The term "transition engineering and manufacturing" was coined by Cambridge Corporation officially in the latter part of 1951, but basically, as I proceed, you will recognize it as a new name for an old technique. Historically this phrase in other forms had considerable meaning in that words like "crash programs", "triple A priority programs", "transition periods" became quite common during World War II. In various Government engineering, design and procurement offices, as well as industrial manufacturing departments, these programs were an everyday problem. For those engaged in Government procurement, these phrases presented no problems. They simply passed the programs on to industry expecting that new products would be quickly designed, manufactured, and made available for use by our military. For industry, this approach to manufacturing was considered a diabolical but guaranteed means of causing ulcers for those who had to solve the problems.

During the war these problems were in some cases solved by means of Government laboratories performing research, development and design and later adapting their investigations to prototype models. These models were passed into industry for transition into finished equipment suitable for volume production. In other cases, the military merely stated a technical requirement and the research and development was carried out by research or educational institutions. In either case there existed the problem of translating research models into production items.

As world War II progressed the various Government laboratories and shops often went further than the prototype model; they also fabricated or built limited quantities of new equipment. In the process they effected a transition from the prototype to a model adaptable to volume production. This was still burdensome to industry as further modification and product engineering was necessary in almost every instance. As a result it became quite evident that, except in very large companies, a serious void existed between research and development groups and the manufacturing groups. This void can be best described as a lack of complete understanding and coordination between the desires of the research and development people and the manufacturing groups from the standpoint of both hardware and time.

Cambridge Corporation decided late in 1951 to bridge the gap between the research, development and engineering phase on the one hand, and regular production for commercial purposes on the other. This is what we call "transition engineering and manufacturing". In this endeavor the company had the full support of the parent companies, the Carrier Corporation, a leader in the air conditioning industry, and Arthur D. Little, Inc., one of the largest industrial research and engineering organizations in this country. It is one thing to recognize that this problem exists,

(*) President, Cambridge Corporation (Subsidiary Arthur D. Little Corporation), Cambridge, Massachusetts).

and another to establish a competent, versatile engineering and manufacturing organization to solve it. This, in the field of mechanical engineering and assembly, we believe has been accomplished at Cambridge with more than modest success.

A most important item in any development program, whether it be pure research or a combination of research, development and manufacturing, is time. Excessive use of time, be it planned or not, is, in the final analysis, money. To a large volume production organization instituting a small development program in a laboratory, coupled with manufacturing limited quantities of the new production, is a costly problem. It means the interruption of existing schedules in engineering laboratories, as well as in the factory. To this type of organization every minute of a work shift is carefully planned and must produce a specific amount of production dollars. On the other hand, a similar situation exists in a small laboratory which sets out to develop a prototype. Costly research and development groups are forced to spend their time on small-scale manufacturing problems. Again this results in increased charges on a research and development program where only limited production may be involved.

Recognizing these limitations Cambridge Corporation has taken the best from both types of organizations and adapted a hard-hitting, fast-moving approach to development, engineering and manufacturing. "Transition engineering and manufacturing" involves a particular method of coordinating and accomplishing development, design and production. For the sake of simplification let us assume that we segregate our operations into engineering, procurement, fabrication, test, and subsequent final transition into equipment suitable for volume production. Personnel assigned to each of these phases are first of all well skilled in performing their specific function, but they are also trained in the associated functions. For example, the Engineering Department is well versed in procurement problems; our procurement people know manufacturing; supervision and management of our manufacturing departments know the requirements of our Engine ring Department -- and so on around the circle. Basically we have established a team composed of a number of people able to do the work required in any stage or phase of a development and manufacturing problem.

The Engineering Department is so organized that the drawings made by the Drafting Department dovetail almost immediately into the requirements of our Factory Engineering Group, which is assigned the responsibility of preparing bills of material, route sheets, estimates, etc. The engineering bills of material are prepared so that they can be used as an authoritative paper permitting the Procurement Department to go into action. These same bills of material can be used by the shop to requisition material from stock for job operations. They are used as a direct guide in drawing up route sheets, job operation and associated papers. The aim is for the engineering, factory and procurement groups to use the same piece of paper for more than one operation, and this has been achieved. As the shop receives material and shop orders for manufacturing operations on the prototype or initial unit, engineering changes will be suggested. These are quickly absorbed in stream and recorded jointly by the shop and the Engineering Department. By the time the initial unit is completed a revised set of drawings, bills of material and other instructions exist which are then used in additional fabrication, if this should be requested by the customer. However, the package of drawings, bills of material, route sheets, test results and pictures, if required, can be turned over to the customer for incorporation into a large manufacturing program. I would like to repeat, the important consideration in transition engineering and manufacturing as we practice it is speed and complete coordination. In most cases engineering and fabrication take place concurrently. Most of us know that production is really the basic food of industry. The wrinkle that transition engineering adds is that the research and development required to develop a new product is coupled in a simultaneous stream with the manufacture of prototype and succeeding units. The important element in that sentence is "simultaneous stream" because it means saving in time and money for our clients.

This system can be made to work in any organization. Obviously in a plant with several thousand employees a group of people must be segregated and assigned to this function. It is obvious that on a large scale the whole company cannot operate on this basis. We believe that the optimum size is approximately 600 to 800 employees, and of course the solution in large companies is a vertical organization where a number of fully integrated departments is established. Another feature of transition engineering that I have not mentioned is testing new equipment in its future environment. The dovetailing process briefly described above also involves fitting new developments into their planned operating condition so that they become a part of a smoothly functioning system. This prevents production "white elephants" or "misfits" by foreseeing the changes which will be required to fit the equipment into its environment.

I would like to describe an actual case history of transition engineering and manufacturing at Cambridge Corporation. We were called upon to develop, design and manufacture a number of refrigerated transport liquified gas containers. Our only guide in this job was a two-page specification supplied by the customer. Development and design were completed, drawings and bills of material prepared, factory route sheet written, raw materials procured, parts and subcontracted services obtained, and the job completed on what seemed to be an impossible schedule. This schedule was set in December 1951 and the delivery date for the initial unit was April 15, 1952, only $3\frac{1}{2}$ months later. The first unit was delivered 14 minutes past 5 o'clock on April 15, 1952. Briefly this equipment consisted of a steel cylinder and associated equipment weighing approximately 10 tons and containing -- under vacuum -- expansion engines for bringing gaseous compressed helium to a temperature approaching liquifaction, i.e., about -432°F; (pistons and cylinders of these engines had to operate lubrication free because of the extreme low temperature range;) electrical and hydraulic controls; compressors, piping and other associated equipment. This unit was connected by vacuum insulated helium piping to a large vacuum insulated stainless steel 2000 liter storage container also weighing about 10 tons which required gaging, piping and controls, together with a unique and intricate internal suspension system providing minimum heat loss. As a matter of fact, the heat loss for this large vacuum vessel was only $4\frac{1}{2}$ watts per hour. Because the entire unit was required to operate at the bottom of the Kelvin scale it was necessary that all joints be vacuum tight to insure thermal isolation, which is a much greater problem than joints requiring pressure tightness only. All machine work and assembly had to meet high quality tolerance standards. The entire unit weighed well over 40,000# and was required to be transported either over the highway or in large transport aircraft. This equipment, I would like to repeat, was developed, designed and fabricated in the short space of $3\frac{1}{2}$ months. As a continuing requirement developed, we manufactured additional units until the contract was completed in the latter part of 1952.

This equipment "before Cambridge" and "after Cambridge" is shown in the following slides. The first slide shows the bread-board laboratory model. After additional development and extensive redesign and modification for production, the finished equipment, also incorporating over-the-road and airborne field test improvements, is shown in the second slide.

If I may at this point blow our own horn a little, here is what the Director of our customer's Laboratory, which handed us the two-page specification, had to say about the equipment and the over-all job:

> "It is a pleasure to thank you for the splendid job which your company did for us during the past year. During that time you overcame, we know, difficulties which appeared at times well-nigh insurmountable. The fact that, coupled with the problems of an entirely new technical development, you met (what appears in retrospect to have been) an impossible schedule, only reflects to your credit".

And further, our customer's Chairman said other nice things:

"Now that the tests have been successfully completed we wish to acknowledge the outstanding contribution of your organization." Needless to say these compliments made us all purr like a well fed tabby cat.

Incidentally, if any of you are in the same state of unenlightenment that I was four months ago, a definition is in order. The equipment which we manufactured is known as cryogenic equipment or that borne of cold. It is, I believe, derived from the Greek works "cryo" meaning cold and "genics" meaning formed from. Our efforts in this field have helped to create a new industry -- the "cryogenic industry". It is still pretty much in its infancy, but at least it is now beyond the research laboratory stage and into its bright, shiny new future.

We have also taken on other development products which we have transition engineered, and established manufacturing departments to undertake production on our own account, still retaining the flexible approach which has proven itself. This has also contributed towards producing a growth of from 100 employees and approximately 30,000 sw. ft. of manufacturing space in 1952 to 700 employees and 140,000 sq. ft. of engineering and manufacturing space in 1954.

To summarize, transition engineering and manufacturing is not new. All industrial organizations have quite obviously practiced it in varying degrees. Every new refrigerator or automobile or machine tool represents the complete range of transition from research, development and design to final production. What we believe is new is that a single company should be organized to offer this service to others. It requires a very versatile team of well chosen and flexible components, each fully aware and appreciative of the others' problems. As I have said, we believe there is a practical limit in organizational size because intimate communication is a very important ingredient to success. It has been successful, but it poses its own problems, principally those having to do with continuity of operations. Obviously it takes very careful planning to have the various transition jobs flow smoothly into and out of the organization. There is also the matter of job priority. For example, in recent months we had a job of such vital national priority and tremendous scope that it soaked up our entire effort. Quite frankly, while we were agreed that this was unhealthy at the time, we had little choice, and we are continuing to diversify our operations. However, the keystone of our corporate enterprise is transition engineering and manufacturing with either limited or unlimited production for Cambridge, thereby supplying what has proven to be a useful and profitable service to industry.

DR. VINSEL: Thank you, Mr. Logan, you gentlemen certainly keep on schedule. I was noticing that there seems to be some connection with every speaker - by the way Mr. Logan in that introduction had the word or term cryogenic, but not being too sure, I did not say anything about it. Remember Will Rogers once said, "We all are ignorant, except in different fields". The next topic, a most timely one for post war activity, is by Mr. Donald G. Malcolm (*) who will tell us - "HOW TO INCREASE PROFITS THROUGH OPERATIONS RESEARCH."

MR. MALCOLM (*): Thank you, Dr. Vinsel -- Gentlemen, I am substituting for my boss, Dr. Ellis A. Johnson, who could not be here, but he asked me to extend his regrets. Some urgent army business at the last minute came up that required his presence in Washington.

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Like the previous speaker, Mr. Logan, I should like to say that this subject field does not propose to be anything new, and in a sense it is merely a conglomeration of a bunch of experiences in approaches to problems that in themselves are old problems, that distilled knowledge represents perhaps the nucleus of a new profession.

I like to refer to operations research as essentially a discipline that does research on operations, and just leave it at that. But this does not have too much meaning so perhaps we should go on a little from there and say that what operations research attempt to do is to critically investigate the structure of an organization, or assist them with the idea in mind that some sort of conceptial may be developed, if not mathematical, a model of that system. This particular model then when one varies the variables in it, one can analyze the effects of changes in those various components of the system, and estimate their effect on the total maximation of the system. Now this has some very interesting aspects.

This ties the operations research here right in line with the decision making process of the company. Quite often you hear the field referred to as "The Science of Decision", but I won't make any such claims for it, but I think it is working in an area where it is analyzing and describing how the system works in a company, in an Army, and attempting to maximize the objective of that system. If it can do that it is doing a very good job. Sometimes even certain of the objectives of the organization have to be analyzed, and in this respect the biologists that have come into operations research have given a slant to the thinking that is sometimes helpful. They view organizations or a company much in the way that they view, research in their own field. They believe that organization of a company may be viewed as a biological accident, and in that sense they free their minds to investigating it, or look at its ends, looking at its objectives, and even being free to come up with thoughts that concern the objectives of the organization as a whole.

The operations research office (the place where I work) has come to the view that operations research can be described by three main attributes. (1) It is conducted in mixed team fashion generally from an inter-displinary approach (I will have a little more to say about that as time goes on), (2) use of the scientific method, the time for research, and (3) total-system approach, where the system as a whole is looked at rather than the parts individually.

Now each of these items that I have mentioned, I am sure you are saying is nothing new, and I certainly agree, industrial engineering for quite a few years has used mixed teams, to solve certain problems, and we have all been trained in engineering to use the scientific methods, it's second nature in problem solving, but perhaps the unique part is the tackling of a total system, or you might put it this way, the conglomeration of these three attitudes and the presence of them organizationally in a company is somewhat unique.

Perhaps a quotation from Dr. Johnson might be in order to show the place that operations research applies to. His thought runs something like this, "The world which a company or organization exists in, is not a simple tidy world, but rather a world that may be described as being non-linear, some are rational, dynamic, conservative, and probablistic." Now this is the sort of a world that an organization exists in. These are the things that an analyst must take into account if he is to arrive at a solution to problems in this general area.

Now the thought comes to mind here that the conservative nature of our world, our business world, has been a thing that has helped make business strong, in many respects. Many companies view that they will have a little more time, and that they can make better decisions about what product they are going to make, how they are going to make it, etc. They are conservative in the sense that it is a customary practice to take the good things that other companies do, pirate research, this sort of an approach is customary in a conservative world. It is good, and it has helped

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However, at the present time, the dynamic characteristics of this world are very important, we are finding particularly in defense work, (work that is connected with the future program of the Army) and Air Force programs, that the new gadgets and new systems come thick and fast, and that this fact means that the very need for survival, and survival of a company depends on them becoming more dynamic. They have to rise to the challenge and make the changes quicker now than they have in the past, so we are seeing an emphasis towards the dynamic aspects of this world, and this attempting to chart the course of a company involves more treatment of a probabilistic nature of the world we live in.

So perhaps you can say that the need for research and operations has largely come about by that transition towards dynamic factors, and the probablistic nature of the world involved. Perhaps it might be well if I indicated a few situations wherein this type of approach might be advantageous.

If you will think with me here of a small (well, not too small) company which has about 800 to 900 employees, that found themselves in this kind of a dilemma, they were interested in reducing a back-log that they had (and by the way, this company is a job-lot type of company) and at the same time they were interested in putting on the market a new type of product that their engineering department had come up with. The problem they had was, if they attempted to squeeze in this new product at this particular time, they would necessarily drag on the back-log, pushing it further back. This, then, would cause them to run the risk of getting cancellations of orders and probably the new product would have to be really good in order to be successful, so management of this company was concerned about the problem and brought in our research team to investigate the problem.

Now what happened - One of the interesting things that happened was the team investigating the problem surveyed management of the company at the outset to determine what their feelings were in regard to what should be done. This was kinda in a nature of seeing what executive reaction is to a problem, and the first thing they noted was across-the-boards, I believe with but one exception, indicated that the solution of this problem, in their minds, was to reduce the in-process inventory of the company.

The thought then here was that this would effect two substantial gains. First, it would reduce the amount of capital tied up in industry, and therefore bring a bigger return, and second, it would reduce floor space occupied in inventory and release that particular space for the new product they desired to put into effect. This was the general reaction. Well, the team investigating the problems felt that a model of this system should be involved, and they set about and in due course arrived at a mathematical expression that described the production system, and by treatment of different calculus methods, they were able to find the minimum inventory level that they should have in that particular company. It was significant to note that the results noted here indicated that inventory should actually be increased.

That increasing the inventory was needed to reduce and minimize the cost of production, and as a by-product also it was possible from doing this to actually increase production, because of the reduction in bottlenecks that were affected and actually reduce part of the production space that was required for this particular series of operations. This, then, enabled them to put in the new production line for the new outlet, and actually, by that means, accomplish both ends, maximizing the product or profit return and getting a new product out at the same time. Well, this is one example.

Another one comes to mind here that I think will show the need for an analytical point of view towards decision-making process. A company that does about three or four million gross a year had an account in their selling expense, which was known

as "returns and allowances". And you can visualize an account there that runs about 25,000 a month, about 10% of the gross sales of the company. This is not a particularly large operation by Ford standards at all, and it is probably something that they could put in their hip pocket, but if we owned that company why it would look like a pretty sizeable return if we were getting 5% of it or something like that. But this returns and allowances account was 10% - $25,000 a month. The President of the company had been concerned over a period of time about the size of the account, as he thought it was too high, and out of line with firms of the same size. He objected to the Vice-President of Sales' approach, in administering that account, and made no bones about it. After some months went by, he took over the account with the idea that he would show this particular Vice-President of Sales how to administer it. Well, his thought was - we will eliminate the account - this is a good industrial engineering approach, isn't it? - he pursued this particular policy of just not having any allowances for defective material from the customers, and literally rejected any returns that came back. They just existed in a vacuum as it were.

Now, this had a very definite effect on the company as you might expect. The effect at first was a good effect. The account for the next two or three months went down to about half what it had been, operating at about 12 or 13,000 a month. This was about 12 or 13,000 a month that ended up in the profit. Now, what did this mean? Well, it looked good at the outset and the President of the company decided that he had shown the Sales man how to administer the account and he turned it back to him and said, "Here you are, son, take it over again", and this then was at the point where trouble started. Two or three irate customers that had been grievously wounded, started suit against the company to reclaim certain damages that they had had in faulty products. This went on for awhile until the Vice-President of Sales essentially got back to the point where he was conducting business where he had in the past. At this point he brought in some help to analyze the problem, and what went on here is somewhat indicative of the kind of an approach that can be made. The analyst looked into the account with the idea of seeing if he could not do something about it to minimize it. Looking into it, he found one of the first things was that the accounting model was inadequate. He could not find out what the assignable causes were with any degree of simplicity.

In other words, it took him a lot of digging to do it, he did not get these figures on a continuous basis. So the first reform that was put in was to break the particular account down into 4 categories which he had by a spot check had found were the major factors which caused the returns and allowances. He broke them down into Production Mistakes - Delivery Mistakes - Delivery-Shipping Mistakes, and also into Policy Returns - where occasionally the company felt that, in order to get future sales, it had to make allowances to certain customers in order to get their continued business. Then after this had been in effect awhile, he noticed that the bulk of the returns and allowances fell under the category of Production Mistakes, about 50% of the dollar value in that account was production mistakes. Now then, the next approach was, what can you do about those mistakes? Can you do anything that will minimize that?

The approach that he took in this case was, you can put on inspection and cut those mistakes out at the source. A step in this direction showed him very quickly that this approach here would actually slow down production, and while you might save a good portion of the 12,000, you would reduce your output significantly in the other direction. Then it was found that the real cause of these mistakes could be gotten at instead of attempting to catch them at the end, was to specify the standards of production. This reflected back up into engineering, and when one went up into engineering, the solution of the problem then came out that the actual methods or process that the company was using was not a satisfactory process, and this then led to the conclusion that the company essentially had to arrive at a new process in order to stay in business.

The reason that I have related this story is to show the circular or continuous nature that this kind of research gets you into. You start out with a problem on one side of the company structure, and by tracing its roots, you find out that the problem turns throughout the entire company.

Another example I can be a little more specific about, concerns a type theory that is used in operations research, known as "Cue-ing Theory", and perhaps you have run into this problem in your own plants. The question often comes up - "How many maintenance men do we need?" - "What is a way of allocating maintenance help?" "How do we arrive at incentives for maintenance people?" This is a particularly knotty problem. One company in particular that we might mention is the company that felt like the maintenance help was sufficient, but yet management from time to time could go out and walk on the production floor and find one of two disturbing factors occurring. While they thought they had sufficient help, they occasionally noticed some machines were down for emergency maintenance, or two, they noticed their maintenance help at other times seemed to be standing around without much to do. This was very disturbing to the company.

An analysis of the company showed that their plans for maintenance had gone something like this. This particular part of the company had 6 machines in it, and they had assigned 1 maintenance man to look over these particular machines. The servicing factor which was the term employed, indicated that the machines came down for repair about 10% of the time. Indicating that a machine that had 10 units of time would be down approximately 1 unit of that time for servicing, or a servicing factor in this case of 10%. With 6 machines on a servicing factor of 1-10th, it would appear that one maintenance man would easily be able to handle that, because common sense might indicate that only 60% of his time would be required in maintenance.

Is there any gimmick in that? Here is the picture again. Machines are requiring emergency maintenance by this particular maintenance man at the rate of 10% of his time. He has 6 machines so he ought to have only 60% of his time occupied in preventive maintenance. The gimmick actually is that the true probablistic nature of that system was not taken into account. It was assumed that these machines came down for emergency maintenance in some sort of pre-arranged schedule, whereas they really came down without any regard to being nice and orderly about it. The company brought in a statistician, and the approach that he made was to have a mathematical model of that particular small system.

His thought was to describe the probability of a certain number of machines waiting in line for maintenance, showing that the probability of M number of machines being down and waiting for maintenance, was equal to factor "A". This is the mathematical statement that shows the probabilities that there will be, in this particular set of six machines, for one maintenance man, remember that this is a very precise model for a precise situation. The probability -- times the servicing factor which would represent the times the machines are down over the time between they come down to the nth power (that would be the number that would be in line, and the probability that there will be zero machines on the line.) This is a statement of the probability that 1-2-3-4-5-6 machines will be down, waiting in line.

Now when this is solved, it turns out there is a probability that there will be 1-2-3 machines waiting in line and it may turn out to be something like this for N equal to 1 the probability is .145. The probability that 2 machines are down waiting in line is .058. The probability of 3 machines waiting in line is .018. The probability of 4 machines down is .004, and there is a very small probability that occasionally you might go out and see 5 machines waiting in line. Now, let me indicate what I have here a little more precisely. We have 6 machines that come down with a servicing factor of one tenth. We have one maintenance man to attend those and we want to know what is the probability or how much percent of the time can we expect to find one machine waiting in line with that man working on another. 14½% of the time in this

system, you could expect to find the maintenance man working on one machine, with one machine down waiting in line. 5-8/10% of the time you can expect to find him working on a down machine with two machines waiting in line - cueing up, - and this is how you get the term - Cueing Theory - and then so on down. Well, the sum of these probabilities turns out to be 22½% of the time. So that you can say that even you have apparently by common sense, only 60% of his time required, you can go out on the production floor and 22½% of the time you can find that he actually has machines waiting on him. Since some of these machines are going to have to wait for a few of them to work out of the line ahead of them, what is the total effect on waste? The system adds these up and by the amount of machines in line, you can make this kind of a statement. 22½% of the time you can expect to have A-1 or more machines down, waiting on servicing, and that they are down on the average that will require one third of the time to repair them, just in waiting. Now, what is the significance of this to a production man?

This indicates more or less the true nature of what you are up against in maintenance in this particular system. It indicates that you can really expect, by planning in this fashion, to have some machines down waiting. If your emphasis is to have no machines out of production, or to minimize it, then perhaps you might want to tackle the amount of maintenance men that you have. You might want to put in more than one. You might, in this case, decide that the added cost of having an additional maintenance man would reduce the total cost or increase the profits that you could make out of this system. It is also interesting to note here that, of the remainder of this time, this turned out to be 22½, the remainder of that time, 78½% of the time, you could expect the time to be divided into two categories - (1) when the maintenance man would be working on one machine with none in line, in the one category, and (2) the second category, when he would be idle with nothing to do, no machines waiting in line and none he was working on. Well, this turns out to break down to these two categories, 48½ and 29% - 48½ is idle - now, if you compare that with our original statement, we would expect him to be working 60% of the time, and idle 40%.

This is the common sense approach you might say. Under this particular system, idle times goes up - he can expect to be idle a little longer, so if you are using work-sampling in the company to determine how idle a man is, and you haven't used this model to describe it, you might come up with a kind of a factor which says he is idle 48½% of the time. He is essentially not working hard enough, where this system will give you some knowledge of what the system should produce in idleness, and what you should expect, and if you are not getting that there is no cause to be alarmed in the system.

So much for that, my time is running on here, and I might conclude here by saying that one can look at operations research as a collection of various techniques that have been evolved in order to analyze action problems. A few of these other techniques that I believe are worth looking into, are such things as organization theory, information theory, feed-back control, etc. The railroads are currently doing some operations research where they are investigating the maintenance and wait problem, and trying to set up a model showing what the actual causal factors are, what the failure of the rails actually looks like. Do Theory is another technique that is coming along. Value Theory, Programming, and these are all tools of what I believe is a challenge to industrial engineering. Essentially, I believe that there is a definite challenge to industrial engineers in modern techniques that are coming out. I believe that research on the way in which business is done, is just as important as research on the product which is produced, and perhaps this is one challenge that industrial engineers should meet. They should look into the particular way their company is organized, and see that they have research provided them, concerning how the company operates, as well as how the product is made. Thank you very much.

DR. VINSEL: Thank you, Mr. Malcolm. I will now introduce the last speaker on the panel, who will speak on "What Operations Research Does for Management, Labor and

Consumer", -- Mr. Richard L. Waddell (*)

MR. WADDELL (*): Thank you, Dr. Vinsel. I am in a pretty tough spot for a number of reasons. This is supposed to be a technical speech and I am not a technician. Also I am among some pretty knowledgeable people, who have preceded me and stolen a bit of my speech -- not, I might say, the mathematics.

Now, I am last on the program and you all are tired, so I will proceed as quickly as possible. I am here to be a "tout" -- and that is a good word in this area -- for operations research. Incidentally, the program has it "operation research" for my talk and for Prof. Malcolm "operations research". It may be a typographical error, but it is also an error that some people make about this. It is "operations research", because it is research into operations.

Now, why am I going to be a tout for O.R.? There are two men in the audience whom I know that represent the reason. One is Mel Salveson who works at General Electric's Louisville plant and the other is Dr. Villers who spoke to you yesterday. I have had occasion to meet both these gentlemen. I had lunch with Dr. Villers and he said he was going to listen to me when I made this talk at Louisville because he was going to argue with me. He does not like this. He is a management consultant, and he has just published a book - I will show it for you, Dr. Villers - Mel Salveson is now in industry, and he likes O.R. In fact he has written a lot about it, and is making practical use of operations research at G.E. He told me he had just saved $56,000 a year on their first project.

Why doesn't management generally -- and maybe industrial engineers -- like O.R.? Perhaps because it has been so full of mathematics, as you can see from Prof. Malcolm's speech. Yet were it not for mathematics, O.R. could not exist. We have words like "biological accidents", "Mathematical marvels", "probablistic" that are a little frightening. It is only human nature that the industrial engineer wants to know where he fits into this picture.

Is O.R. going to take over management? No, that is not true. About the only statistics I know is that 2 plus 2 used to equal four. I think in the atomic age that 2 plus 2 equals five. Still I have followed O.R. from its conception, at least in industry. The first meeting was at Case Institute, before there was an Operations Research Society of America. I spent 3 or 4 days there, and frankly did not know what in the world they were talking about, but it sounded good. When I went to Carnegie Tech to a meeting there, they called the idea "A Statistical Approach to Business Problems". I talked to the Arthur D. Little people and sat in on one of their discussions about their O.R. consulting group. I would like to quote Philip Morse, author of the original book in the country (incidentally, "Operations Research" is a product of England and not America). His definition is the "operations research is the application of scientific methods to the operations of an organization to provide executives with a quantitative basis for sound decision making".

Burton Crane of the New York Times, who writes that paper's Business Book Section, was reviewing a book that has just been published, "Challenge to Modern Management". He wrote: "Operations Research is a kind of "Mein Kampf" for the mathematicians, serving notice that they are in the process of taking over everything." That is a little far-fetched. But it does raise the question: In layman's terms, what is operations research? It is a team concept of solving business problems. I have covered business thinking for a number of years and am surprised at its lack of objectivity. This is the main reason of operations research -- objective thinking -- and it works for management, for employees, and for the public.

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A scientist, a statistician, a mathematician -- any one of them, can contribute. But they do have one thing in common. That is they are trained as scientists and they have a scientific attitude. They are not involved in the operation of the business so that they can take a very calculated point of view. What they are attempting to do, as you can see from all the mathematics, is to quantifies the intangibles. This is the thing many people don't like about operations research. They say it can't be done. Still it has been done. The Case Institute group studied a housing project, where it should be located, in Chicago. They even quantified politics. Unfortunately the politicians did not agree with them, so they went somewhere else. But it was a good idea. Double-entry bookkeeping is probably the original operations research. It used to be you had so much money in your till when the day started, and at the end of the day, you had so much, and whatever was the difference, well, that was what you made. Of course, you did not know statistically how you made it, what were the contributing factors. You just made money, and that is what business is for. But business has come a long way with financial statements, which are detailed, very deeply detailed, regarding the operations of the company. A financial statement, therefore, is in a sense operations research. Yet that does not mean that the accountant sets the policy of the company. Management still sets the policy of the company. If management wants to lose money, the accountant can tell him how to do it, but it is the decision of management to do it.

Now, operations research just goes deeper, that is all. Dollars are very easy to play with. They are tangible. But operations research uses the same sort of technique in non-financial areas. Why all the fuss and bother about operations research? At the risk of being corrected, I think that the value of it is immeasurable, and it could not exist were it not for the new computing machines. There are vast formulas that would take long periods of time to work out, too much time, if it were not for the calculation machines. Beyond that, there are new mathematical tools that have become available in fairly recent years out of the scientific laboratories. Then there is another reason. Charles Knight of Monsanto Chemical Co's Plastic Division wrote in Mechanical Engineering of April, 1954: "This type of approach (he is talking about advanced planning, forecasting, computers, etc.) has been employed already by the armed forces in long range logistic operations, convoy planning and attack plans, and may be called operations research." He goes on to say that if we are to have automatic factories, operations research must be adopted by management.

This is good for the company, it is good for the consumer. Ford Motor Company can produce a cheaper car if it knows its operations as intimately as it might from operations research. From the laboring point of view, operations research has a hidden advantage. The objection to operations research sometimes arises from persons like Dr. Villers because it seems to lack the human quality, the human element. It is so cold, it is so calculating, where does "the man" enter into it? He is just a guy who is a number, a symbol.

A consultant to John Hopkins operations research unit is Brig. General S.L.A. Marshall who has done a lot of operations research work for the military. He has written a book, "The River and the Gauntlet", the story of the retreat from the Yalu River in the Korean War. It is written from the data that he collected as an operations research analyst of the military in Korea. I will appreciate it if you will bear with me while I read from page 39. It's the chapter called "The Stonewall Company". The Stonewall Company was the first company which got hit by five Chinese armies which we did not know were even across the Yalu. He says:

"Twenty-six hours earlier, they had been a company of 129 able bodied men. Now there were 34, including at least 5 or 6 who, like Sieger, had wounds. The rest were dead or wounded. If any of them were made prisoners, it was not known to the company. Likewise unknown were the names of the numbers of men who had died bravely fighting

"for Baker company. Some were ROK soldiers who had fought along with the company but had remained nameless to their comrades. Others were Americans but recently arrived, and were known only as 'that Polish fellow' or 'the guy from Boston' to the men who had seen them die. The reader can judge how many medals for valor were well won in this fight. It is certainly only that few were ever given. In the weeks which followed the great November battle, Baker company had no typewriters and no clerical help. The awarding of medals requires the writing of many polished words on reams of paper. There was neither time nor material for that. Those who were left had to concentrate their efforts to rebuilding Baker into a battle-worthy unit. But probably that made little difference to Wallace and his men. During the assembly of the company at which the story of Hill 219 was reconstructed, the subject of awards happened to be mentioned. Crawford spoke up saying, 'There is a little girl in Virginia with whom I happen to be in love. The honor of being returned to the United States, so that I can marry her, is the only reward I want from a grateful government'. But then Crawford was only". Gentlemen, I rest my case for operations research on that. Thank you.

DR. VINSEL: Thank you, Mr. Waddell. Speaking about mathematics and statistics, you had in mind possibly the engineer they called on to determine the height of a bridge which was to be constructed on a river, so he carefully measured the height of all the boats and vessels on the river, and took the average. I attend quite a few banquets - and you have one item I know you are going to enjoy, this afternoon trip to General Electric. It is really quite a sight, but there is one that really intrigues me. Every convention at the end of two days should have a "Vitality Banquet", that comes next to comfortable chairs, I think.

THIRD SESSION: CRITIQUE AND CONCLUSIONS: Theme: New Top Management Techniques.

DR. VINSEL: I wish I could stay with you through the Critique, but I have an executive committee meeting at noon, and I need a little time to prepare for the meeting, because this meeting is rather an important committee assembly. President of your host chapter, Dean Sorensen, has kindly consented to carry the ball from this point. Itwas truly an interesting morning for me here, I assure you.

MR. SORENSEN: Thank you very much, Dr. Vinsel. We regret that you cannot stay with us all day. I hope it will be possible for you to join us tonight and absorb the "word vitamins" of the "VITALITY BANQUET" at 6:00 P.M. The first question is for Mr. Kaye. "Do you use tabulated or your own stop watch standards?"

MR. KAYE: We use our own stop watch standards, as we have developed them within our plants.

MR. SORENSEN: "In your variable indirect budget, do you use step budgets to control indirect manpower?"

MR. KAYE: By step budgets, I presume the reference is to various volumes requiring a difference, in a quantitative difference in manpower. To that I would say, "Yes," however budgets as such, (the indirect manpower budgets) are being developed and generated on the basis of studies of the specific jobs.

MR. SORENSEN: "What basis do you use in setting basic manpower, budget standards, for staff or service departments?"

MR. KAYE: Those budgets are developed on a policy type of basis, and are usually brought about by a staff or a policy decision. Particularly insofar as foreman are required, or other technical people. It is decided that they will be in existence. It is further decided that the quantities likened to the number of people, or the activity that they may have some control or responsibility over, will govern the quantity of those people.

MR. SORENSEN: "In the steel industry, no standards can be set on day work jobs (according to union contract) how does your firm get unions to work to standards without incentive?"

MR. KAYE: The one exception to the day work method of payment we have at Ford Motor is the steel manufacturing activity that we have to use a prevailing incentive wage payment system. However, that, to my knowledge, is the only one in existence with Ford Motor.

MR. SORENSEN: "Do you have a Supervisory bonus for standard performance?"

MR. KAYE: No, we do not. There is no bonus associated with performance as such, to my knowledge.

MR. SORENSEN: "Are fixed costs based on zero production in an idle plant? If not, at what percent of normal volume does your company consider fixed costs are valid?"

MR. KAYE: Are fixed costs based on zero production in an idle plant? If not, at what percent of normal volume does your company consider fixed costs are valid? I repeated that interesting question, and frankly we don't contemplate any idle facilities to begin with. As a matter of fact, our facilities are pretty well taxed to their full capacity at the present time and have been for some time. What is happening in Louisville is happening in several other places. We are having to build new and expanding facilities to relieve as much as possible the volumes of

difficulties that we have today. We do not, to my knowledge, determine any fixed asset cost based on idle equipment and we do not (as a matter of interest) consider fixed cost at any other basis but a standard volume basis, which is accepted as I understand it, within the industry, and is the accepted pattern for determining those costs.

MR. SORENSEN: "How does the Ford Motor Company ascertain the maintenance of production standards that may be used as a true basis for the comparison of the relative operating effectiveness of plants in the multi plant organizational system?"

MR. KAYE: I think I used two specific terms - work standard and productive standard. We do have a central system (and I am not speaking for Ford Motor) but for Ford Division and for similar components of the company. Ford Motor, I might add, since decentralization, is broken down into operating divisions, of which the Ford Division is merely a part, the Mercury Division is another, and the various other activities, manufacturing activities within the company are similarly broken down into parts of the parent organization. There, Ford Division and its related or similar components does establish a system of standards. I think the question is, in the relationship of the concept of work standards and production standards. Work standards to us is a central determination. In other words, it is determined at a central point, and related to the production standards as they occur within the industry in the individual plants. Basically, our car is somewhat similar - it is similar in all our plants - however, the conditions vary and change by reason of the mix, by reason of the customer preference for certain optional equipment, or certain styles within that area, that manufacturing or assembling area. Therefore, it is a very simple matter to relate what a specific plant is doing by using a series of combinations from the central standards.

MR. SORENSEN: "If inter-plant comparisons are made of total and operational performance from a cost per unit viewpoint, then what factors are used to evaluate the differences between plant layouts and/or methods?"

MR. KAYE: I think that is kind of a multiple question. Plant layouts and methods - I mentioned that we do have a very definite correlation between quality control standards and product production or manufacturing engineering. The requirements of those are the same in each and every plant. They find their expression primarily through the worker performing his job. Therefore, it's the central standard by that reason then, becomes (if I am using this word correctly) the epitome of all the engineering requirements plus the work task in each one of our plants. For that reason then, and taking a simple example of spot welding. Centrally, we determine that it will require X number of spot welds to weld or join two pieces together. Since the engineering information may be separated through various means within the Company, and passed on to the individual plants, in our standards that is definitely related to our work task and the evaluation of it. The plant however, on the other hand, through the diligently watching and observing their local plant practices, may learn and determine that in their production standards the number of welds may vary by some dogree in relation to the central standard. That kind of an approach enables us to carefully watch and compare from one plant to another, particularly in our 15 or 16 plant structures. What each plant is expected and required to do. By the same token, insofar as methods are concerned, obviously, and we can use the same example of welding, the welding method employed requires a specific type of tool, however, we have a great deal of variability between our operations and it is entirely possible that a specific plant could be using other than the prescribed welding tool. Therefore, the central standard again related that method to the central standard. Now the in-plant methods are interesting because that is where we get a great deal of knowledge from each one of our plant forces, wherein there is constantly undergoing in each one of our plants, the standards group does observe very carefully the methods that are being used and we get sort of a two-way reaction by reason of the fact that since we

are in constant communication with our plants, and in the methods they employ we relate those facts to the central standards, and we can pass on to our other plants the advantages of methods of improvements. I might mention, too, that from an engineering standpoint, it has been found to be a pretty large job, and very recently an engineering component of our division has inaugurated a system that is directed to standardizing as much as possible the vast tooling requirements in each one of our plants, into an integrated solid best-method type of approach, from a tooling viewpoint. That does not necessarily close the door either, since while a tool may be developed for company-wide use, division-wide use, yet it does not close the door to further research for methods of improvements within our plants.

MR. SORENSEN: Here's the last question - "What is the basic factor you use to determine what your car sales will be for a future year?"

MR. KAYE: I am afraid I am unable to answer that question. I'll leave that up to plant management, or the statistical people. Wonder if there are any Chrysler people in the room?"

MR. SORENSEN: How about the second part of this question: "What per cent of accuracy do you attain in your cost estimates in a budget?"

MR. KAYE: I am not trying to give you a "round robin" answer, but our budgets are prepared some six, seven, eight months - we have one of our controllers here and I think he will verify that, ahead of production dates. It is awfully important from the very inception of the model to keep abreast of the contemplated changes that present themselves in the - four years hence - car. That, coupled with the knowledge of people who all have plant background, who have worked in the various plants within our system, coupled with the fact that they do know their job. They do, in my opinion, an extremely fine job of estimating what the future budget involves. I might bring up another very significant point, that might place some emphasis on the accuracy of the budget to this degree, inasmuch as we are working on budgets that far in advance of the actual production date, we also know that the engineering in the automotive industry is something that is a real-rapid fire type of activity, is not sufficiently completed. In other words, peeking over the shoulders of the engineers on their drawing boards, we have to determine or simulate or guess mostly, at what the finished product will be, and to the best of our judgment we attempt to make an accurate a guess as possible. The important thing is, that when the estimate is made, there is a very definite system for corrolating the estimates as they have been arrived at by reason of the engineering not being fully resolved to the actual production engineering product. I think that answers your question, doesn't it?

MR. SORENSEN: "Can you explain briefly the mechanics of your variable budget technique, and what action is taken when actuals vary from standards?"

MR. KAYE: I happened to be in New York last week, at the S. A. M. Meeting and got involved with some other automotive people, when the same question came up. All of the details would be pretty lengthy to explain at the moment, and frankly, we haven't worked out some of the problems we have. As some of the problems we have involve, as an example, power unloading. Unloading may vary from day to day by reason of not having the people available to do it. Those details are in the process you might say of the pioneering stage. We don't have all of the details worked out. I might just pose this to you: we recognize the problem and we recognize the situation involved in the problem, and we are energetically, we think, trying to resolve it.

MR. SORENSEN: Now it's your turn, Mr. Logan, as we have a few questions for you. "How long does it take to reduce the temperature of a unit volume of a gas to the lower end of the Kelvin (sp) scale with the equipment you described?"

MR. LOGAN: That is a hard question, because I have to try and remember the figures. It depends principally upon the amount of the refrigeration built into the equipment. I don't remember the conversion rates, but let me put it this way. We were building a liquifier in conjunction with Arthur D. Little, which had a rate of liquifying the gas at 50 liters per hour. Now this means 5/6 of a liter per minute with a liquifaction temperature of 20° Kelvin (actually a little under 20° Kelvin which is roughly -425° F). I don't remember the conversion factor from a liter of gas to a liter of liquid at atmospheric pressure and temperature, so I give you the production in liters per minute. Another type of equipment which was built by Arthur D. Little, in which we participated, and used quite widely in cryogenic work in Laboratories principally produces 2 liters per hour of liquid helium. This is a much tougher job because helium liquifies at 4° Kelvin, which is about -450° F. The amount of refrigeration built into the equipment was smaller because this piece of apparatus is about the size of an office desk. Those are the figures I remember off hand, but it will give you the order of magnitude. The equipment that we showed the picture of is actually not a liquifier but merely a zero boil-off storage container, and our experience with the time from a hot-start where the equipment is warm, or stand-by condition, to where it was ready to receive liquid gas on a zero boil-off basis was about 8 hours. This is quite a large piece of machinery, and the principal parts had to be cooled down so it took us roughly 8 hours to get it into what we call a cold stand-by position where it was ready to receive liquid gas."

MR. SORENSEN: How about this one, Mr. Logan: "Has not World War II and the stepped-up defense program brought about a much quicker transition period from design to actual product?"

MR. LOGAN: I think very definitely so. During the 20 or 25 years prior to World War II, research and development by and large, were fairly leisurely. The transition from the prototype to production manufacture took quite some time, and I can recollect from previous experience with General Electric Company, that development programs extended over a number of years before they were ready for quantity production. The required speed-up in World War II, in our opinion, emphasized the gap between research and development and manufacturing because of the short-time requirements. Everything was foreshortened, and this brought out all the defects in our industrial system of transition from research and development into production. I think it is very much faster now than it was prior to World War II.

MR. SORENSEN: The last question: "What is the place of the industrial engineer in your organization in this transition engineering?"

MR. LOGAN: It is a very key place depending on how broad a definition you make of an industrial engineer, and for the purpose of answering the question, I will broaden it to include two types of manufacturing engineers on which we put a lot of emphasis. The first we call process engineers; the second, tool engineers. I think these two terms are self-explanatory. Also they are probably what the individual who asked the question means by an industrial engineer. Our ratio in the organization, both in the home factory and engineering office in Cambridge, plus our field operations in Denver, was roughly 1 for 1 between industrial engineers and the development and design engineers.

MR. SORENSEN: Thank you very much, Mr. Logan. Now for Professor Malcolm. "Since the end results of Operations Research will effect the worker, how is it being accepted when many members of Management have not the mathematical knowledge, much less the worker, to understand the resulting changes. The mathematician, like most scientists, is like the concert violinist who becomes wrapped up in his work and often overlooks the human element."

PROF. MALCOLM: That is a good question and one that is important, also one that we industrial engineers have been working with a long time. A psychologist approach is necessary, together with very elaborate surveys of the long and continuous reac-. tion.

MR. SORENSEN: "Please re-identify variables in your formula?" and Prof. Malcolm I think you can answer this question at the same time,"'How do you calculate the 48% idle time.'"

PROF. MALCOLM: A good source of information about this, and I think you might want to investigate it, is William Feller's book, "Probability in its Application." Identifying these variables, this theory is a practorial (sp) expression, something like this - (enclosed drawing): M x M-1, on down to M-n-+1, and M refers to the number of machines you have involved. N refers to the number that you want to investigate, that are waiting in line. Obviously this is designed for say 6 machines, in the example we used here, where M was 6. N can't be any greater than 5, can it? and you can never have more than 5 waiting in line, of 6 total machines. Again over (mu-sp) representing the servicing factor, and the way I described it very simplified, I assumed that was a constant of one tenth. Gamma (sp) would represent the amount of time it takes you to service the machine, that is the amount of time it takes to repair on an emergency basis, and mu would represent the average interval between breakdowns, I assumed that these were averages and worked it out in this way. P_o represents the probability that o machines are down, and one has to go back to derive a basic theory to bring that out. I don't think I will attempt that right at this time, but if you care to look further, you can get that pretty well worked out.

MR. SORENSEN: One more: "Does your statistical approach to the probability of machine down-time assume that all machines are in the same mechanical condition?"

PROF MALCOLM: Well, the way I have talked about this here, it assumes that this is an average condition, and actually, if you put in the individual probabilities of all machines, that would take into account the condition of each and every machine. This should be done in an adequate statement of the problem. It was not done here, but it should be taken into account.

MR. SORENSEN: Thank you, Professor Malcolm. Mr. Waddel, we have some questions for you. "It is possible to quantify any intangible if you know the proper scale of measurement. What assurance do we have that the scales we use in quantifying policies, for example, have any validity? Isn't it possible that the scale of measurements may not respond to reality leading to unreliable results?"

MR. WADDEL: Well, about the only thing you can say to that question, is, that after all, there is one point about this operation research; you know Management, and some people in Management, like to call it an art. There have been some books written using that title, "The Art of Management," and I presume there is some art in it, but there is one thing else, and that is intuition, and we still have a lot of intuitive management. Well, that is O.K., if you are right, but management often makes decisions and they are right decisions, but they do not know why they are right, and operations research attempts to make decisions, and give management a set of choices, and tell them what is behind those choices, so that they can make an adequate decision. Sure, your measurements of mathematics may be wrong, but so may your intuition, so you are not losing anything by it. In fact, you are gaining a lot more knowledge about the operation than you would have if you did not do it at all. Besides that, there is a percentage of errors, and you know what the chances of being wrong are. So if you have (for instance) an operations research team tell you that if you do this, this is going to happen, they will say it will happen with this much probability in it. I am not defending mathematicians; I think they do pretty well.

MR. SORENSEN: "What are the pro's and con's of why the operations staff must be made up of personnel outside the company?"

MR. WADDEL: Well, I don't know whether it is a fact. I don't think I made myself clear. I don't think it has to be outside the company, although Arthur D. Little will tell you it should be. There is an advantage in it, as there is in any consultant, that he can look at things objectively without the emotion involved because his career, his pocket-book is affected by what his relationship is with people he is studying. So if you divorce yourself, for instance, if you were studying the engineering department at Ford, and you were a member of that department, and you had to make a criticism of the boss, you would hesitate to bring about an answer. That would be natural, but if you were outside, it would not make any difference what your answer was, as far as you personally were concerned. Then you would probably have a more correct answer.

MR. SORENSEN: "What is actually the difference between the fundamental concepts of operations research, and the fundamental concepts of the scientific management movement, as they were stated in the early 1900's by Hugo Diemer, among others?"

MR. WADDEL: It depends on how you define the word fundamentals. The fundamental concepts of O. R. is, of course, scientific attitudes, and that is old -- well beyond 1900. So there is not any essential difference. However, the difference is that you use the scientific attitude to look to the whole operation, and not at a piece of the operation. Take time study -- sure, you use a scientific attitude on time study, but you just take one piece of an operation and apply the scientific attitude. Perhaps an operations research group would tell you to throw out time study and get your money back - you are losing money by it, and you don't know it. God forbid, but maybe that is what would happen.

MR. SORENSEN: Another one: "Is there room for an industrial engineer on the operations research team, or is operations research reserved exclusively for scientists?"

MR. WADDEL: I don't think that you can declassify industrial engineers as non-scientists, in the first place; and in the second place, this question was brought to my attention when I attended the Case Institute Meeting, where Dr. Churchman spoke and I sat and listened to him on a panel discussion. Incidentally, that is where the politics came up. He was trying to explain the problem of ranking methods (I think that is what they call it) and he explained that this is the way they determined what values and quantities they put on the variable factors such as politics, in determining where you put this settlement, and you write down as many factors as you can possibly think of that will effect the position of this settling house, and when a group of men determine by intuition (if you will) what importance is attached to each factor, and thus translate it into mathematic figures. Isn't that right? (Aside to audience remark). There is some objection to that, though.

MR. WADDEL: There is, undoubtedly. Now to get back to the question. The people who attended the case meeting, were many of them industrial engineers, sent there by their companies because they heard this thing written about in Business Week, in a very light-handed way, and they wanted to know what in the heck it was all about, and they came away (many of them that I sat with) with either (1) that they could not understand this high-powered stuff that was thrown at them or (2) this is (what the heck) what we are doing already. So I should say that on the basis of that, that yes, the industrial engineer could play a big role on the operations research team. Isn't that right? (Audience remark). I would like to say something there --

MR. WADDELL: Well, he is an industrial engineer. (audience remark) Yes, claiming to be an industrial engineer, I think that there is a definite spot on the operations research team for an industrial engineer. I know that in our organization in Wash-

ington, we have several that contribute very well in that area, and that is why I believe that the one thing you can state about the problem is, that industrial engineering essentially tackles similar kinds of problems, as operations research has, and perhaps the only main difference is the fact that there is a little more statistical background than some of the operations research approach.

MR. WADDEL: If you are interested in operations research, and I gave these comments to a group of McGraw-Hill editors who are technicians - they are trade book people and technicians in their own rights, while Business Week people are more or less journalists, and they were interested and they asked for more information, and where they could get it. Well, there are two societies in our various "growings" today, and I think it is a rivalry that is a healthy condition. One is the Operations Research of America, which grew out of the group which did the military work, and there is a new one which has just been formed called The Institute of Management Scientists. Professor Cooper at Carnegie Tech. is, I think, President of that, and both of them in a sense are operations research. They both use mathematical model building, a lot of statistics, and Mr. Salveson, correct me if I am wrong, but isn't that right, essentially?

MR. SALVESON: Yes, you're right.

MR. WADDEL: So take your choice, with either one, and you will get a lot out of it, and I know that the Institute of Management Scientists is looking for members and I presume so is the Operations Society.

MR. LEHRER: Personally, I think it is about time that we quit kidding ourselves, and time that we realize that operations research is something for outsiders, that it is something new, something that is the product of scientists. I think that we all recognize that operations research is a potent tool of industrial engineering, and that aside from making up any deficiencies that we may have in terms of our own capabilities, if we effectively use operations research, there are a number of reasons why operations research is a bad thing to many industrial engineers. If more realization is made that operation research is a specialist tool, that has a most valuable use to industrial engineers as a fact finding organization, which would give information to management, so that management can effectively make adequate decisions based upon knowledge of the facts.

DR. VILLERS: Inasmuch as Mr. Waddell mentioned my name and to avoid any misunderstanding as to how I feel about Operations Research, let me say that I fully agree with Bob Lehrer's statement. I hope that he will reprint it in the JOURNAL he so ably publishes for us, and this will greatly contribute to the clarification of a very confused situation in our field of industrial engineering.

Somewhere in his writings Dr. Einstein stated something to the effect that the formulae of mathematics are just a tool, not a way of thinking. What is important in Operations Research is the concept of integration of all activities of the industrial enterprise much more important than the mathematical models proposed to effect this integration. It is only proper to add that industrial engineers have long ago understood and said that such an integration was the ultimate goal of scientific management. The application of statistical concepts and a mathematical approach to some of the problems faced in industrial management may well solve difficulties that up to now have appeared as insuperable. We should be careful, however, to resist the temptation to put human nature in equation. Human feelings, human relations escape quantitative measurements and it would be unfortunate to go too far in the right direction by attempting to submit to mathematical treatment phenomena which cannot and - I dare say - should not be quantitatively measured. The average duration of human life can be computed, but human reactions to either a kind or a harsh treatment, to leadership or lack of leadership, to family problems, etc., seem to defy the

the most involved computations - and indeed quite a few of us are happy that they do. This being said, I want to make clear that I am deeply interested by Operations Research, that I think that Operations Research deserves a lot of attention, especially from us, industrial engineers, and that we can find inspiration and guidance in the work conducted by the Operations Research teams.

MR. SORENSEN: Gentlemen, our time is up. Lunch will be served in two minutes. Thank you for a very lively critique, sorry time will not permit for stating conclusions.

FOURTH SESSION: Thursday, May 6, 1954, 12:00 (Noon)
Theme: "Automation in Operation"
Presiding Officer: Mr. Cleve Rumble, Director, Employee Relations, Courier-Journal & Louisville Times

MR. RUMBLE: Ladies and Gentlemen: -- I want to add my welcome to others who have welcomed you to Louisville, and give a welcome from my paper, the Courier-Journal and Louisville Times. As I am a Director of Employee Relations over there at those papers, people don't bother me particularly, but I can remember when I would have been very scared to appear before a group of engineers, and then one day I discovered that engineers are people too, so I have been getting along with fellows of your breed ever since. The general theme of this luncheon is "Automation in Operation", and I am sure that word means something to you; but I found it very intriguing. I found out that it means imagination working automatically, getting the most out of machinery without human hands. I guess it is a kind of imagination that is built into the design and operation of the equipment.

This afternoon we will have an opportunity to see some phases of Automation in Operation at the new General Electric Plant, located here in Louisville. But first, let me introduce you to Mr. J. W. McNairy, the Plant Manager of Appliance Park, General Electric Plant. He will prepare you for the inspection trip by giving us a blow by blow description of this new plant. Mr. McNairy:

MR. McNAIRY: Thank you, Mr. Rumble. Ladies and Gentlemen, I hope that I do not disappoint you in devoting most of my time to a description of a new manufacturing facility known as Appliance Park which our Company is establishing here in Louisville, and in which my primary interest lies. While I know from your program that your principal concern for the afternoon is Automation in Operation, Appliance Park in its broad concept might be considered to be a sort of a glorified automation set up, since one of its primary objectives is the utilization of the most modern equipment and techniques available, and we therefore thought some of the details of this rather large industrial undertaking might fit in at this time, with your inspection trip coming later today when you will be able to observe first hand some of the automation achieved in the equipment.

Appliance Park is an example of faith in the future of the Company in very practical form, and in the future of the electrical appliance business. Those of us who are privileged to be associated with the construction and operation of this new and outstanding production unit are impressed by our tremendous opportunity, which under the charter of its construction throws a challenge to engineering in general and particularly industrial engineering, in such a fashion that there can be no alibis. It constitutes an opportunity of a lifetime for industrial engineers of the General Electric Company, and its equipment suppliers, to show their wares and abilities, and we think this is important because the opportunity presented by this undertaking is almost unlimited from a standpoint of scrapping the old and starting with the new.

SLIDE (ARCHITECT'S COLORED DRAWING OF APPLIANCE PARK) Here is the architect's original drawing of our project. It shows the five large manufacturing buildings which are all similar in structural detail, but one or more of which is assigned to each of our self-contained operating departments. These will be operated as completely decentralized business units which house both the manufacturing facilities and all the administrative and technical personnel involved in each of these businesses. The Administration Building which has been shown on this plan is, however, now deferred indefinitely, and no such unit will be built until Appliance Park begins to pay off.

A consolidated Warehouse, so-called because it will store all the products manufactured at the Park and will permit us to ship consolidated cars of such products to our distribution, is shown in the background. The proposed Warehouse, as shown on this layout, is approximately 400 feet wide by 2,000 feet long, with an area of 800,000 square feet. Actually, it will be built in steps tailored to our needs - the first step which will be some 380,000 square feet, is planned for construction starting sometime late this year. To tell you the story of Appliance Park, I must show you the progress that we have made to date.

SLIDE - (PROPERTY IN ORIGINAL STATE). This slide shows the 43 small plots of land, home sites and farms which we acquired just about 3 years ago. It was on July 7, 1951, that we turned the first spade full of dirt on this location and started construction. The total plant area is 942 acres. Existing facilities, however, are being confined to the 670 acres between Black Mud Lane, Bank of Buechel Road, Fegenbush Lane, and Old Shepherdsville Road. Of these 670 acres, 400 acres will be actively used in the operating areas. Our total buildings will cover 4,000,000 square feet which is almost 100 acres under roof. Our layout will also include more than 60 acres of parking lots which will accommodate 8,000 cars at one time.

SLIDE - (ERECTION OF STEEL). In September, 1951, we erected the first piece of steel beginning Building #1, which was being rushed at that time for Jet Engine Parts manufacture.

SLIDE - (VIEW OF PLANT). Here is a view of construction in March, 1954. It shows what we have achieved in buildings and grounds and construction in a little more than two and one-half years. Calling the nearest Building to you in the Picture, #1, it is the Home Laundry Building; next #2 is the Electric Range Building; #3 is the Electric Sink and Dishwasher Building; #4 the Refrigerator Unit Building; #5 the largest building of all, shown under construction in the distance, is the Refrigerator Cabinet and Assembly Building.

We consider the overall Park to be about 70% complete, as shown in this picture, and the whole project will be finished sometime in 1956. Some structural details of these buildings might interest you. The first three manufacturing buildings already constructed are 600 feet wide; two of them are over 800 feet in length; and #3 building is initially 440 feet in length. Building #1 is 880 feet long and is the largest existing building and provides some 528,000 square feet of manufacturing space for Home Laundry Equipment which, excluding office, is about 13 acres of floor space under a single roof. This building could completely house 10 football fields. Building #2 could house the Yankee Stadium. The largest manufacturing building so far planned will be #5, which will be used by the Refrigerator Department for refrigerator cabinets and assembly. It will be 700 feet wide and 1,000 feet long, excluding the office. It will have 700,000 square feet of manufacturing area of ground area. That's about 15 football fields. Including Mezzanine, total square feet will be 1,000,000.

All of these manufacturing buildings of ours are so constructed that they could be easily lengthened to a total length of 1,500 feet or more by extending them to the rear. All of the utility services, railway tracks, etc., are so arranged that they need not be disturbed if and when it is decided to lengthen them in this manner. The manufacturing buildings are also spaced so that the standard steel trusses used inside the structures will readily fit between them, allowing for easy expansion side-wise in both directions. The joining of all buildings could be accomplished easily if this should prove desirable sometime in the distant future, and a single building almost 3/4 mile wide by 1,500 feet long would be possible. I haven't the slightest idea at this time what we might do with such an enormous building. The

basic design of these structures is such as to make them most flexible in their application and use, and they can accommodate the manufacture of a wide variety of products with a minimum of change. They are particularly well adapted to the production of products requiring so-called conveyorized or line high production manufacture. The inside of the buildings provide unusually high headroom clearances varying from 27 to 43 feet. This makes them not only well adapted for the extensive conveyor systems now required, but also makes possible the addition of mezzanines for further increasing the floor space under existing roofs. These buildings have large, 100 foot by 40 foot, clear bays. They are outstanding in this regard, with excellent flexibility insofar as equipment layout is concerned.

SLIDE -(CONVEYORS). The manufacture of major appliances is, of course, based largely on the extensive use of conveyors. We expect to have about 42 miles of them. One of the existing buildings has 7 miles; #2, the Range Building, almost 9 miles, and Building #5 will have approximately 15 miles.

SLIDE - (CONVEYOR BUILDING 2). This picture of a section of the conveyors in Building #2, Range Building, I think illustrates the intense use we make of the overhead area, and the need for high clearance under the trusses.

SLIDE - (SIDE VIEW OF BUILDING). The side walls enclosing the steel structures making up our manufacturing buildings at Appliance Park have aluminum siding made of Reynolds Aluminum with blue and grey color effect. The glass is translucent and of a type having low heat transmission. It is therefore effective in reducing internal working temperatures under summer conditions. A fresh air supply for all buildings is brought in through ventilating fans and is filtered through oil filters because of the necessity of reducing dust and dirt in the building atmosphere to a minimum to manufacture our so-called "white goods". Some of the units are equipped with heating coils for winter operation. We still have hopes that we will be able to keep all of these buildings under positive pressure with 3 air changes per hour in the summer and 1.3 air changes per hour in the winter - if we can only keep the doors closed.

SLIDE - (AIR VIEW OF BLISTERS). We have designed Appliance Park, as you would expect, to make maximum use of electrical power for all purposes. The total ultimate power requirement is therefore quite high - probably 80,000 KW or more. Measured in more ordinary terms, this amount of power would be adequate for supplying a city of around 200,000 homes. A considerable part of this electrical load is created by the use of electric type enameling furnaces and paint dryers. This large amount of power is distributed by what is considered to be one of the most modern and efficient industrial power distribution networks so far developed. It makes use of a number of high voltage substations distributed throughout each building. For instance, Building #1 has eight. They are housed in "blisters", or penthouses, which are visible on the roofs of the buildings in this picture. These blisters are large enough to accommodate complete air conditioning equipment, in addition to the electric substations, for air conditioning our manufacturing areas, if this should ever become necessary or desirable. Today only the offices and special process areas are air conditioned.

BUILDING #2: This is typical of the general type manufacturing facility we are setting up at Appliance Park, and some measure of the mechanization of this Building will be indicated by the fact that every production employee has under his control on the average 70 H.P. It is estimated that 28,000,000 feet of wire will be consumed in wiring the Ranges manufactured in this Building in a single year. This is enough to reach from New York to Honolulu.

SLIDE-(TRESTLE). When you visit the plant today, you will undoubtedly notice that while the primary purpose of this trestle is to carry steam, power and compressed

air lines to all the manufacturing buildings, it has a second most important function in that it is designed to carry two product conveyor lines on the way to the consolidated warehouse and these will be constructed in the very near future. An interesting feature is that these trestles make use of standard building trusses - as you can see from the picture. The design is such that they will be built directly into Building #3, when and if it is extended. They will become an integral part of the building structure without disturbing any of the service lines to the plant. This is an important consideration for the future when expansions have to be made after the plant is in operation.

SLIDE -(BOILER HOUSE). The Boiler House at Appliance Park is very modern in design and we think it is, architecturally speaking, one of the best appearing units so far constructed. It will ultimately house 6 boilers, each with a capacity of 150,000 pounds of steam per hour at 250 pound pressure, with total capacity of 900,000 pounds per hour. Putting this in more understandable terms, the steam it can supply would be sufficient to heat at least 15,000 average homes. When this ultimate Boiler Plant is going full rate, it will be consuming from 20 to 25 carloads of coal per day. Three boilers are presently operating, and a fourth is under construction. While this picture is intended to give you a good view of this Boiler House, I should tell you that it was taken on the first day's operation. We were plenty happy to see that smoke coming from the stack on that particular day because it meant we finally had steam and would not freeze up. The picture rather graphically illustrates, however, what could happen if the Boiler House were operating in this conventional manner and we had not gone to considerable expense to make good on a commitment to the community for smoke elimination.

SLIDE - (IRATE HOUSEWIFE). We don't propose to have conditions such as are illustrated here around Appliance Park. We consider this lady to be not only our neighbor but our customer for our appliances, as well.

SLIDE - (RAILROAD TRACKAGE). Maybe some of the other overall operating figures at the Park will be of interest. For instance - we expect to have some 20 miles of internal railroad track within the Park, served by both the Southern and L & N Railroads. These tracks will handle some 300 railroad cars per day. Our in-plant traffic will also include some 200 trucks daily when we reach a maximum rate of production. We will operate our own railroad. Our locomotives will be radio dispatched, as will our in-plant taxi type transportation system which will be on call by radio for passenger transportation between buildings inside the Plant site.

Believe it or not, water is one of the basic materials used in large quantity in the manufacture of our products. To supply this need, we make use of two systems: (1) The Louisville Water Company with whom we are now tied in for a capacity of about 10,000,000 gallons per day. (2) We also have an internal so-called millwater system with a reservoir storage capacity of 4,000,000 gallons and an additional delivery capacity of 10,000,000 gallons per day. This reservoir and secondary water system serves the threefold purpose of conservation of uncontaminated Louisville water for reuse; supplying cooling water for office air conditioning and other cooling uses; and as a storage reservoir for fire protection. In addition to the storage of uncontaminated used city water, the system will store a considerable quantity of rain water. Emergency diesel engine driven pumps are provided for use in the event electric power should be interrupted during fires. This millwater system alone is capable of supplying a city of 100,000 homes, or 320,000 people.

SLIDE - (INDUSTRIAL WASTE TREATMENT). This is a picture of our Industrial Waste Treatment Plant for treating our Industrial Waste to meet the standards required by the State and Metropolitan Sewer District authorities for discharge of our waste into the Metropolitan system.

This system is interesting in that it represents the lowest cost unit of the kind that we have been so far able to develop for the volume involved in its operation, and this is brought about almost entirely by setting up the operation on a continuous basis of treating the wastes as they go by, as contrasted with the older type systems where batch treatments were used. For the first time, this continuous treatment is possible because of recent developments in instruments and control devices, giving immediate indications to conditions and rapid response to push button controls for correction. Both the Water Company services and the Sewer services to the Park were built on a cooperative basis with existing agencies and with the General Electric Company providing the capital for the new facilities necessary to supply all General Electric requirements.

SLIDE - (ARBORETUM AND BUILDINGS). Appliance Park, as its name implies, is being made a park in line with a tradition which has grown up in the General Electric Company, beginning with the Nela Park of the Lamp Division at Cleveland; followed by Electronics Park, Syracuse; and now Appliance Park, Louisville. The Park atmosphere is fitting in connection with consumer products, and while it involves a very considerable investment in landscaping, shrubs, etc., we believe it pays off in such products particularly of our white-goods variety in better quality; and in better community employee and customer relations. The landscaping is a complete plan prepared by Berg and Dahl, internationally known Louisville landscaping architects.

SLIDE - (ARBORETUM). The plantings shown on this picture are for the north Arboretum which is practically completed and is the first of two. We are told by our landscaping architects that these Arboretums will be of considerable interest scientifically and when completed will be unique in this territory. They will compare very favorably with the nearest competitive one in Chicago. The initial planting of some 5,000 trees of some 700 varieties is already completed. They will be tagged and recorded in a permanent catalog. There is well over 60 acres of planted grass in the north unit alone and there will, of course, be a total of two acres of this kind. Additional plantings either have been or will be made around the sides of the buildings and there will be border screen planting to hide unsightly manufacturing operations in the rear, or west, where this seems advisable.

SLIDE - (FRONT ENTRANCE OF BUILDING). This picture is typical of the treatment of the front entrances of our main manufacturing buildings.

SLIDE - (ADMINISTRATION BUILDING). Here is the artist's drawing which will give some indication of what the main Administration Building might look like some day.

NEW EQUIPMENT AND AUTOMATION: As I said at the beginning, I have noted in the program that this afternoon is to be devoted to Automation in Operation, and quite obviously Automation in Operation can best be seen in the plant, and only there in operation. However, I have brought along a few slides which might suggest to you some areas of interest, and there will be many others when you are at the plant this afternoon.

SLIDE - (LARGE PRESS). For instance, in Building #2, I think you will find this press installation of interest. First, these are two unusually large presses 850 ton capacity each. They extend 25 feet above the floor and 12 feet below it. The most outstanding feature is the use of the progressive dies in this single press which does three operations on every stroke. These replace three ordinary presses which would otherwise be used with three single independent equivalent operations. The particular advantage from our viewpoint of this single press installation is better automatic transfer of parts between the operations with better quality and lower cost. You will also find this a fairly good example of automation in material handling in advance of the press operations when you inspect this unit, and I believe you will find the complete installation to be good automation.

I also commend to your attention the flow-coat paint installation in this Building #2, which is a good example of automatic painting with zero process labor.

SLIDE - (CONVEYOR SYSTEM). I think those of you who are particularly interested in automation of material handling will find in Building #2 extensive conveyor systems based on the so-called power and free systems with automatic routing and switching of the hangers or carriers. I also suggest you might want to look at the automatic spray type pickeling installation in thise building, with specific attention to the power free type automatic conveyor system that is associated with it.

SLIDE - (RANSBURG PAINT SPRAY). In Building #1, the Home Laundry Equipment Building, you will find a most modern example of automatic spray painting making use of so-called Ransburg system. As many of you probably know, a paint fog is created by spinning cups or discs which throw the paint out into a very fine mist. The paint is then deposited electrically by an electrostatic field, which attracts the paint fog particles to the parts being painted. This results in the utilization of 98% of all the paint used, as contrasted to the 40 or 50% of the old water washed types.

SLIDE - (TUB FABRICATION). Another point of interest from the fabrication viewpoint is the new installation for the fabrication of the tubs for automatic washers.

SLIDE - (TUB FABRICATION). While automation is not complete the machine involved is fully automatic and more complete automation of the handling of parts is underway. This represents something of a new departure from the viewpoint of methods and cost saving of the fabrication of such a large tub, eliminating relatively large expensive presses with very deep draws.

SLIDE - (PICK UP CONVEYOR). You will find an example of automation in the conveyor system of this same Building #1, which is somewhat typical of similar installations in other departments, the feature of which is the automatic classification of finished products as they come off the production line to provide a proper mix between dryers and automatic washers as they go to the warehouse.

SLIDE Z-1 -(MONOVEYOR). The assembly conveyor lines of Building #1 are interesting from the viewpoint of positioning the product for minimum effort during assembly, and of particular interest, although not shown on any slide is the automation of the test set up for automatic washers with traveling power and water supplies. You may also notice that the conveyor system automatically removes a rejected machine and fills the open position on the line with a reworked one. These are only a few of the random examples for which slides were available. Again I am sure you will discover others of interest.

SLIDE Z-2 (Univac). As I said at the beginning my objective in showing these items is to arouse your curiosity, and I am sure that you will find many other points of interest, one of which I do not want to pass up and that is the new installation of our UNIVAC at Appliance Park. You are to be shown this unit and it represents the ultimate to date in the automation of bookkeeping and accounting - going all the way from the making out of payrolls to the developing of important statistical information in a very short period of time. I am sure you know something of this development in mechanization of accounting, and our installation is the first devoted strictly to industrial accounting operations. Obviously UNIVAC is a subject in itself and cannot be covered this noon, but I am sure you will find it interesting and won't want to miss it.

We believe that we are going to make Appliance Park, Kentucky, the Major Appliance center of the world. We hope you see in it all the potential we see. We also hope that you will spend a few days with us again after we have completed our construction program so that we can show you all of Appliance Park. We hope it comes up to our claims and your expectations when you see it today.

In closing, I might say this - we believe that we are going to make Louisville the Appliance Capitol of the World. We put down that kind of an investment here that should be evident that we believe in that. We hope that you will see in this plant as you go through it, all the pleasure that we see in it. We hope that you will come back again when the place is complete. We welcome the opportunity to show you engineers what kind of a set-up we have, we hope that we will continually draw to us capable talent, and that we can get a lot of fine ideas. We don't often say this, but we appreciate the many outstanding vendors who are making important contributions in this area, so we hope that you see Appliance Park and that it will come up to your specifications. Thank you very much.

MR. RUMBIE. Mr. McNairy, we want to thank you very much for a very thoughtful and stimulating presentation.

SESSION FIVE: Friday, May 7, 1954, 8:30 A.M.

Theme: "Looking to the Future".
Presiding Officer: Mr. Jean Clos, Exec. Sec'y, Jefferson County Medical Assn.
TV News Analyst, Station WKIO, Louisville, Kentucky

MR. DERRY: This is our final session of the Conference. We are fortunate to have with us as Presiding Officer -- a friend at heart. To him the Louisville Chapter is endebted for the excellent radio support. He interviewed Mr. Warren Lamb of London, England, when he spoke here in Louisville. He devoted 12 minutes of his 15 minute News Program to that interview. He also appeared as Moderator at one of our Chapter Meetings, on the subject "WHY ENGINEER REGISTRATION"---. He devoted 14 minutes of a 15 minute news program to interviewing the President of National Society of Professional Engineers, Mr. John D. Coleman, when that group met here for the first time last Spring. In Louisville he is recognized as one of the keenest News Analysts. His Sunday evening program, "Clos Look At the News" over WKIO has the largest listening audience in the Ohio Valley. He interprets the news in terms understandable to his listeners, which are mainly composed of business men, educators, etc. His other role is Executive Secretary of the Jefferson County Medical Society. I present to you our good friend, Mr. Jean Clos:

JEAN CLOS: Thank you, Mr. Derry. It is a lovely compliment that Steve has paid me, but I assure you that I do feel as if I was coming home, when I joined you this morning. In the words of that famous old college song, I am a hell of an engineer, never having practiced, but my heart is with you because as a news man I have consistently stood on tip toe to look into tomorrow, and I have always had to do it by climbing on the shoulders of an engineer to get that vantage point, into what tomorrow is really going to be, and mean, to everyone, and it is with that same spirit that I join you this morning, because to me this is a most significant session. What we shall do here this morning is to listen to evaluations, and a formula for an integrated tomorrow. We will listen to them from four diversed viewpoints, and more than that, I think that we will find coming up with each one of them, the age old concept of the part the individual will play in any plan for tomorrow, and I leave that particular thought with you, for after this session, we will welcome the most distinguished speakers, you gentlemen, to join in the general discussion with questions. More than that, it seems to me, first from my experience as a newsman, and secondly, my association with the medical profession, that you gentlemen as engineers, of material are in certain respects, very very close, to the medical profession, who are in a sense, engineers on the human body. Both of you, to me anyway, are diplomats on a world wide stage. Because the economic pattern that you are developing, that you are planning, that you are setting, by your individual efforts, will have a sure impact on the peoples of the world, as any of the bowings and the courtesies that go on at the Quai D'Orsay, or at Number 10 Downing Street. The physician with his little black bag and the role of mercy that he is spreading throughout the vast plains and plateaus of Asia, is a certain and sure diplomatic emissary, so are you, the engineers, as you go forth and spin out of what may seem the phantasy of yesterday into the reality of tomorrow. A concrete plan for doing something a little better, a little easier, and thereby bringing surcease from a certain amount of misery, of inconvenience to a little human being, one person, so that you once again are on a one to one relationship, with every other individual in the world. Now that is a rather philosophical introduction to a most concrete discussion. Let's look to the future. I would like to turn to the first speaker. Mr. Paul W. Fritag, Jr. (*), has done many things, and many exciting things, for a company that has not only literally stood on tip toe and looked into the future, but is working in the future right now. "Tomorrow's Mass Transportation" is his subject. I think he will tell you some starting developments in this past decade.

(*) Project Engineer, Industrial Products Division, The Goodyear Tire and Rubber Company, Akron, Ohio.

I give you tomorrow, -- I give you Paul Fritag.

MR. FRITAG: Thank you very much, Mr. Clos, for that wonderful introduction.

PASSENGER CONVEYORS: Since the dawn of history, mankind has been concerned with moving himself from one spot to another. To get where he wanted to go man has used his feet, animals, sleds, carts, buggies, trains, auto, ships and planes.

Now in the middle of the 20th Century, man still has his transportation woes. Our streets are clogged with cars. Suburban living has added to the difficulty of getting between home and work. In our major cities, congestion almost brings us to a standstill. The immense growth of our population has created a demand for some new form of transportation. Noted transit engineers have stated that the only solution to mass transit problems is in some revolutionary development -- such as a belt conveyor system. Some newly developed method is desirable, primarily because existing types cannot be expanded sufficiently. The answer often is not in bigger and better busses and streetcars, which add to the congestion by collecting large groups of persons at one spot, but in smaller cars operating in the continuous flow principle, underground or overhead.

The idea of using a moving sidewalk is not new. Among the popular attractions at the Chicago World's Fair of 1893 was a moving platform consisting of an arrangement of slat like boards on a chain drive. This was built on a pier extending out into Lake Michigan. At the Paris Exposition of 1900 a moving platform of a more ambitious nature was built. This unit had a total length of 10,900 feet and carried over 7 million people. Since then, similar moving platforms have been used at various fairs.

To achieve the desire to move people over a given distance with some mechanical aid, has been in the minds of inventors for many years and they have been trying to adopt the principles of conveyorization to the field of human transportation. Through the years there have been many designs and schemes devised and patented. Some showed promise but most were impractical.

The rapid development in recent years and the new concept of passenger belt conveyors was hastened by Col. Sidney H. Bingham, Executive Director and General Manager of the New York City Transit Authority and a noted transportation consultant, who had urged, back in 1948, the utilization of the passenger conveyor belt principle as a solution for a number of underground transit problems. Specifically, Col. Bingham had in mind a form of passenger conveyor to replace the aging subways presently in shuttle service between Grand Central and Times Square in New York City.

Certainly if engineers could design belt conveyor systems to handle tremendous tonnages and cover long distances over rough terrain, they could apply the principle of continuous flow to the movement of people. The challenge of designing an efficient, economically practical and safe passenger conveyor belt system was accepted by the Goodyear Tire and Rubber Company. Soon they were joined in this effort by The Stephens-Adamson Mfg. Company and coordinated their engineering efforts and tackled the major problems of loading and unloading passengers, feasible speeds, allowable inclines, negotiating of bends and curves, and methods of accelerating and decelerating, among many other technical details.

Visionary thinking by their top management set the lead for all-out creative thinking, research, design, building and testing of models in the development of this new mode of transportation. New ideas, whether complex or simple, take time to gain acceptance and to overcome the inertia of past practices. Many skeptics said it couldn't be done or it will not work. Not until full scale models were built, did the op-

ponents of passenger belt systems rescind. After visually seeing and actually riding the model, many of them have become its greatest advocates.

EARLY DEVELOPMENT: In the development work, it was found that the passenger conveyor problem resolved itself into two distinct and basic phases. One phase involved moving passengers short straight distances at constant speeds approximating the normal walking pace.

The second phase was the movement of passengers over longer distances with acceleration to -- and deceleration from -- considerably higher rates of speed. Travel could be around bends and curves and at variable rates of speed.

From this analysis it was decided to evolve two independent passenger conveyor systems. The first system, called the "Speedwalk" meets the conditions and limitations outlined in phase one. The second system, called the "Carveyor" incorporates the "Speedwalk" as part of its overall design to meet the conditions of phase two.

SPEEDWALK: The Speedwalk, or moving rubber sidewalk, is simply a flat conveyor belt, the surface of which is smooth with no transverse cracks or openings, moving over closely spaced idlers or sliding over a flat plate structural member. In operation, a passenger steps on the moving belt at one end and walks at his normal pace or stands still, while being carried to the exit point. He leaves the Speedwalk by stepping off the belt. The belt moves silently and continuously at a designated speed. Experiments have shown the Speedwalk will operate satisfactorily at speeds ranging from 100 to 250 feet per minute.

Using an electric motor drive with a variable speed reducer, it is a minor adjustment to regulate the speed of the passenger belt at whatever rate experience or conditions dictate as satisfactory. However, 132 feet per minute (1½ miles per hour) which is approximately half normal walking speed, seems to be the most satisfactory at this time. By reversing the motor, the Speedwalk can be made to operate either backward or forward to meet the demands of morning or evening rush hour, i.e., in whatever direction the traffic is heaviest. Dual units could operate in one direction during predominately one direction traffic and in opposite directions the remainder of the time.

To separate the moving belt surface from the adjacent side areas and to eliminate the chance or desire for a person to step off sideways, the moving belt would have the side enclosures or balustrading of anodized aluminum or painted steel panels. While fairly inclined units, (above 10%), such as would be used in ramp sections, might have moving handrails, there would be no need for them on the more common and longer horizontal runs. If desirable, the entry and exit portions can be guided by moving handrails. However, handrails do increase the cost considerably.

The slider type method has a distinct advantage in that it is considerably less expensive. However, if the length is very long or the load is heavy, the friction between the belt and plate becomes quite high. This could mean the belt tension requirements and the Hp required become economically impractical.

The Speedwalk offers continuous, quiet operation and freedom from dust, fumes or vibration. Over long periods of years of service in regular industrial applications, conveyor belts have proved highly dependable, with a minimum of maintenance and repairs required. Electrical consumption is amazingly low. Operating supervision, such as guards are unnecessary. Safety hazards are nil. In the event of a power failure a mechanical brake will hold the belt stationary if the Speedwalk is built on an incline. A stop button is located at entrance and exit to the conveyor to stop the machinery in an emergency. Indoor applications, weather conditions would not

materially effect the belt as they are frequently exposed to the elements in outdoor industrial applications. However, it is recommended that they be covered to offer a sheltered passageway to the user. Complete side enclosures would not be needed. Many shopping centers and stores are presently using an attractive type of horizontal or marguee type of covering over their walking areas.

Speedwalk units can be of varying widths, dependent upon the desired capacity. Probably the most popular size would be a two lane unit using a 42" wide belt and having an outside dimension of balustrading of approximately five feet. Dead and live load on a typical cross section of 42" slider type would total about 230 lbs. per linear foot. On a roller type this figure would be 280 lbs. Since the load is transferred through two channels, only four feet apart, the entire load would be dispersed through the five foot width of the unit. On a per square foot loading basis, the total weights are only 46 lbs. and 56 lbs. Most building codes covering public passageways require a design for 100 lb. loading per square foot. This means that a Speedwalk unit could be installed in a present building arcade or passageway without any additional structural reinforcing. No special foundation or floor mountings are needed. Due to its compact design, the moving surface is only nine inches above the surrounding floor. This does require a short ramp at each end for entry or exit. In new construction the moving surface elevation the same as the surrounding walking area. This would require very little design change in a reinforced concrete beam or steel structure.

Actually tests made on a nine foot wide belt at Stephens-Adamson's, Aurora, Illinois, plant reveal a very favorable psychological reaction in that the user, as he walks on the slower moving belt surface, gets the impression that he is moving at the rate of an extremely fast walk or even running, although his actual walking and exertion are at his normal rate. This favorable impression, of course, is due to the combined speeds; the belt's $1\frac{1}{2}$ miles speed and the walker's 3 mile average giving a total of $4\frac{1}{2}$ miles per hour. Long distances are no longer a detriment. Actually, in any given distance, the Speedwalk user walks only 2/3 of the distance and the moving belt has carried him the rest of the way. Without a Speedwalk, a person would walk the entire distance which would require 50% more time, more walking and more effort.

While theoretical length is virtually limitless as steel cable tension member conveyor belts could be used, a practical walking distance governs the actual length which would be used. Surveys indicate that the maximum distance a person will walk without undue complaining or going elsewhere to park or shop, is about 700 feet. Based on this figure the theoretical practical limit of a moving sidewalk traveling at $1\frac{1}{2}$ miles per hour, is 1050 feet. This may be in one long continuous length with no cross-overs or side entry or exit points. There are three methods of entry or exit. (1) Entrance or exit at the beginning or end of the moving belt system or by depressing a length of belt beneath a stationary cross plate which also permits cross traffic. (2) A side angular plate cantilevered over the belt at zero clearance. A person may enter or leave by continuing his forward motion in the direction of belt travel. (3) The use of short paralleling belts going at the identical speed as the main belt and butting up against the main belt onto which the user walks diagonally across to or from the main belt. Enter and exit are still in the direction of belt travel. This method also permits cross traffic.

Speedwalk units are as safe as any moving thing can be. In entering, or leaving, no noticeable affect is encountered. All that the user does is to continue at his normal walking pace and the transition is made with complete ease. Both entrance and exit are simpler than on a moving stairway because there is no necessity to place the feet at a particular spot. A specially developed edge eliminates the change of anything getting caught and pulled down between the belt and the stationary surface at the point of exit as the belt descends around the pulley. Should a person be

standing still and absent-mindedly come to the end of the unit and not step off, he would smoothly ride off without any difficulty. All types of individuals, small chilren hardly able to walk, elderly people assistad by canes, mothers with children in their arms, crippled people on crutches, all have used the full scale test units without any difficulty.

Plans are being formulated and studied to draw up a code covering the installation of moving rubber sidewalks either for adoption or to act as a guide for local authorities. Cost of Speedwalk units varies on the simplicity or elaborateness of design, lengths involved, width and type. Service and convenience to the user should be the determining factor in judging the value of Speedwalk system in each individual case.

USES: An airport serves as an example of how Speedwalks can help alleviate congestion and inconvenience. At an airport equipped with Speedwalks, a passenger could theoretically step from his parked car onto a moving belt to carry him into the terminal. After checking in, he would enter another Speedwalk and be carried out to the gate position. Regional shopping centers are coming out from their embryonic state and are appearing all across the nation. With their vast acreage and immense parking facilities they offer innumerable opportunities for Speedwalk applications. While the suburban areas expand, downtown America is also beginning to revitalize itself. Business men, engineers, architects are accepting the challenge to overcome the problem of confusion and congestion. In this age of mechanization, they are beginning to look at their buildings and streets, just as they would look at any machine or piece of equipment. That is, modernize it to do a more effective job and replace it before it is worn out. Parking is the biggest problem. Parking areas have 3 big things to sell: space - time - service. The prime considerations are accessibility and lowest possible investment. However, these two requirements tend to repel themselves. The closer we consider a parking facility to a business section, the more costly it becomes - higher land values and higher taxes.

Perimeter or fringe parking offers lower investment, but what about accessibility? The walking distance is the most important. Using Speedwalk systems permits accessibility, low investment and operating cost to reach their optimum. That multi-story parking garage 700 - 1000 feet away won't be avoided if the user can mentally and physically cut down the distance. Fringe highways would disperse the cars directly to nearby garages and eliminate many of the cars from driving around business areas looking for a place to park. Cities such as Kansas City, Los Angeles, St. Louis, Atlanta, are showing far sighted planning by planning and building such highways now. The possibility exists that the local merchants who are being served by the facilities could participate or absorb the cost of the Speedwalk. This may be carried to the extent of their installing a Speedwalk directly from their store to the parking facility. Railroad stations, stadiums, racetracks and factories also offer many possibilities.

Late this month the first commercial Speedwalk will open at the Hudson & Manhattan Erie station stop in Jersey City. This is a railroad connection used daily by thousands of commuters who work in New York City and live in suburban New Jersey. Let's think for a moment what this installation means. This is not the presentation of only a new idea to the public. This is not a miniature or test model. This is not a novel installation such as an application at a fair might be classified. This is an ACTUALITY -- for the FIRST TIME IN HISTORY people in their ordinary daily activity will be able to ride and use a moving sidewalk.

Changing trains in Jersey City has meant a long walk through a passageway, including an uphill ramp. This particular grade on which the Speedwalk is being installed has been nicknamed "cardiac ramp" by the weary commuters. The moving sidewalk will be

227 feet long, 137 feet of which is on a 10% incline. It will be 66" wide, a 3 lane unit with a capacity of 10,800 people per hour. The belt will be reversible in direction and will operate at about 1½ miles per hour. A 20 HP motor will power the unit. The Speedwalk will help disperse and spread the crowd besides offering them a new convenience and service.

CARVEYORS: The second phase of passenger conveyor systems is the carveyor. It was designed to meet the specific underground transportation problem of the subway shuttle service in New York City as originally outlined by Col. Bingham. In 1951 the idea was conceived as to how to provide continuous motion and transfer people from one speed to another, and in 1953 a working model of the entire system proved the basic soundness of the design features.

The Carveyor incorporates the use of Speedwalk units as continuously moving loading and unloading platforms from which passengers can enter and leave the small passenger cars which ride conveyor belts and change speed by going over banks of accelerator-decelerator wheels. The plan's basic feature is to provide continuous, two-way transportation between two specific points at speeds comparable with today's subway operations.

The Carveyor incorporates the use of Speedwalk units as loading and unloading platforms. Conveyor belts are also used at high speeds to transport the small passenger cars between terminal points. Banks of wheels accelerate and decelerate the cars and provide the means for making the necessary turns in the system.

Passengers at the station platform entrance walk upon the moving loading belts which travel at the rate of 1½ miles per hour. Parallel to and moving at the same rate is the passenger car loading belt. Small passenger cars with seats for 10 people in each car and room for five or six standees, ride on this belt. Nineteen cars enter the loading area and pass the loading platform every minute. There is no relative motion between the moving platform belts and the cars, as they are both moving at identical speeds. The effect is the same as being on a stationary platform with a row of cars always there.

There is no gap between the loading area and the car, such as is found in any present day station having a raised platform. The small cars are actually overriding the entering and exiting platform belts. As the individual cars travel bumper to bumper through these areas, no one can fall, jump or get pushed in front of oncoming cars. The tendency to rush and delay trains by holding the doors open is eliminated as there is always a continuous row of cars moving through the station, and able to handle all those who enter the loading belt. This feature, the elimination of batch loading and the resultant elimination of congestion, is one of the system's principle advantages.

From the loading platform, the passengers step into an empty car as it arrives in the loading area. Stepping into the car is as simple and easy as stepping through any doorway. Doors open automatically as the cars reach the predetermined loading point and slowly close prior to the time the cars leave the loading area and clear the platform. As an additional safety measure, a platform guard would be stationed at each platform in the area where the car door shuts. The passenger loading belt is 9 feet wide and 60 feet long. The car loading belt is of the same length, but only five feet in width as the cars overhang the belt. The cars are closely spaced, bumper to bumper, as they ride on the car loading belts. When the cars have passed the loading platform, they are gradually accelerated by a seventy-four foot bank of accelerator wheels which speed the cars from 1½ to 15 miles per hour. Spacing between the cars is increased to about 70 feet as they move onto the main line conveyor belt which is running at a constant speed of 15 miles per hour.

At the other terminal, the passenger cars are slowed down to 1½ miles per hour on a bank of decelerator wheels. The cars are actually being braked and do not coast. Riding bumper to bumper on the unloading belt, the cars enter the unloading platform area and the doors open automatically. Passengers step out onto the unloading platform, moving at the same 1½ miles per hour speed, and walk or ride to the exit at the end of the belt. After unloading, the car doors automatically close, the cars are turned 180 degrees on banks of roller wheels, and again enter the loading area. The continuous operation will eliminate present waiting periods between trains and relieve rush hour congestion. Entry and exit are on opposite sides so there is no cross flow of traffic to fight against.

Present shuttle running time is approximately 2 3/4 minutes along with an average waiting time between trains of two minutes making a total of 4 3/4 minutes. The time to cover the same distance on the continuously moving Carveyor is just under two minutes, never requiring any wait for a train. Capacity of this Carveyor system is estimated to be about 18,000 passengers per hour in each direction, which is almost 50% more than the present hourly peak.

The distance between Grand Central and Times Square measures slightly more than a half mile. Preliminary estimates to replace the present shuttle subway with a Carveyor system would cost about $1000 per foot. This does not include any cost of tunnel modifications. It is important to note that the equipment cost per foot would be reduced if there were a greater distance between the terminal points so that the more expensive station costs would be spread over a bigger area. One engineering headache which has necessitated the adoption of slip clutches to each one of the roller drives on the accelerator and decelerator banks, is the problem of maintaining the same angular velocity at all of the accelerator and decelerator wheels which may be contacting a single car at any one time. The use of this method virtually eliminates all slippage against the bottom of the car and on the tires, eliminating the problem of excessive tire wear.

In conventional mass transit vehicles, passenger discomfort is caused by either vertical or lateral motion or a combination of the two. In addition passengers are subjected to uncomfortable fluctuations (rate of change) in acceleration and braking. The cars on the Carveyor system can develop neither vertical or lateral motion. They are brought up to speed at a constant rate of acceleration without any disturbing fluctuations. The braking rate is likewise constant and causes no discomfort.

Another major problem is the coordination of the movement of the cars to maintain the proper spacing while passing from the different belts to the rollers, etc. This solution lies in the use of electrical variable frequency controls or mechanical controls.

BROADER USES: While originally conceived for continuous straight line use between two busy stations, the Carveyor system has broader application in mass transportation due primarily to the accelerating-decelerating features and to the ability of the system to negotiate curves and bends. By utilizing both an unloading belt and a loading belt in succession, way stations can be incorporated into the systems which makes it practical for general transit use in heavy traveled areas or serves as feeder lines to present main line subways.

Installed costs of the Carveyor system are estimated to be less than 6 percent of the cost of conventional subway equipment in existing tunnels. Operation and maintenance costs of the conveyor are estimated at 40 per cent of similar charges for the conventional subway. New construction for a Carveyor subway would be less costly because of less excavation and smaller tunnels required.

The above advantages now make it possible for cities which had once planned to incorporate subways in their transit plans but have not been able to do so because of continuing rising costs, to once again consider the form of rapid transit.

The desired system capacity would determine the size of car used which in turn determines the inside of tunnel dimensions. A car 4' x 7' long would have a capacity of 4 seats plus room for 2 standees. At a loading platform speed of 1½ miles per hour we have a capacity of 6,840 people per hour for this size car. In a 7' x 7' car we can reach a capacity of 18,000 per hour. In using a 4' wide car there should be a minimum clearance of 18" between the car and the tunnel wall which would permit maintenance of this side. Major maintenance such as lubrication of equipment and so forth would be accomplished between the two parallel runs of "tracks". The minimum distance at this point should be 2 ft. between the sides of the cars. This makes a total inside tunnel width of 13'0". As the car is only about 7'3" high and would require about 18" between the case of the car and the tunnel floor, with possibly a one foot clearance above the car, minimum inside tunnel dimensions are 13' wide by 10' high. In area, this is about the size normally required for a single subway car. Using a 7' x 7' car, a two directional system would require a minimum width of 19 feet. Car capacities can vary anywhere from one to 20 per car.

Because of the narrow width requirement consideration could be given to running the system under the sidewalk area which may be already excavated. While a speed of 15 miles per hour on the main run belt satisfies the speed requirement under 42nd Street, it by no means represents the possible maximum.

Stations between terminal points would consist of unloading and loading platform belts adjacent to each other. A station length of only 180' would be required to adequately serve the system. Again, a substantial cost saving from the conventional concept of an underground system.

If necessary, steeper vertical grades are negotiable than what trains could normally handle. While it is desirable to keep the system running in as long a straight axis as possible, horizontal curves of any degree can be used. The radii used would be quite variable depending upon conditions.

The passenger conveyor system is equally adaptable to operation as an elevated system. Overhead structures to carry the Carveyor require relatively light supports inasmuch as the load is distributed evenly rather than in peaks and there is no heavy massive moving equipment. In business and shopping areas there is a growing trend to install marquees to offer protection from the elements to the pedestrians and "dress up" their buildings. A similar type structure could support an esthetically designed enclosure for the Carveyor. Such a system would have none of the drawbacks of the old "El" structure. There would be no dirt, no steel dust, no noise, no massive structure or darkened street area.

While New York City transit engineers are carefully studying the Carveyor proposal, interest has been shown by other cities not only in the U.S., but throughout the world. Transit engineers are intrigued by the many outstanding advantages. No other plan or system of moving belts for rapid human transportation ever has been presented which compare with the merits of the Goodyear, Stephens-Adamson design to meet the exacting requirements for safety, economy and efficiency demanded in transit operations. These advantages are: (1) the ultimate in safety - chance of accidents virtually eliminated. (2) continuous service - dependable, no waiting, the cars always there, average time between stations as fast or faster than at present. (3) Versatility - under street or sidewalk area or overhead. Ability to handle curves and steeper grades. (4) Lower original cost - lower equipment cost and similar tunnel and station area required. (5) Improved operation and lower

performance cost - freedom from noise, dust and excessive vibration. Less labor and power required. (6) Lower maintenance and replacement cost - simplicty in structure and moving parts, due to the nature of equipment.

FUTURE: All signs point to major long-term face-liftings in the design and planning of our cities, shopping areas, airports, parking facilities, and other recreational, commercial and industrial facilities. Passenger conveyors will play a part in bringing on these changes. The future transition will see Speedwalk and Carveyor systems or a combination of both, as key integral parts of the development. Just as millions of tons of bulk material are being transported daily on belt conveyors swiftly, surely, safely, without delay and with far greater economy than had been thought possible, so will passenger belt conveyor systems become a part of our life, being confined only to the extent of our ingenuity and growth.

MR. CLOS: Thank you, Mr. Freitag, for an enlightening talk. We want to move on to the second gentleman on your panel this morning. He is another man who sorta teeters on the threshold of tomorrow, Mr. H. A. Bergen (*). I give you tomorrow - I give you "Tomorrow's Uses of 3-D Layout", Mr. Bergen (*).

MR. BERGEN: Thank you, Mr. Clos. Good morning, gentlemen. I would like to make it clear at the outset that I am speaking not as an engineer with shirt-sleeve experience in the use of 3-D models, rather, I am speaking as an engineer in the editorial business, who has the subject of 3-D models as one assignment.

In recent years, business and professional magazines have reported on the 3-D models; each publication has taken a point of view suited to its own editorial program, and suited to the needs of its readership. It is fair to assume that all of us here have assimilated some of the material that has been reported to date.

Now then, let's take a look at some of the aspects of the subject which may bear on the future. For the future -- 3-D models will be used where new design principles are understudy, and where something "different" is being planned. How "new" or how "different", is something that must be determined in justifying the expense of a model -- just, as in many other things, the matter of degree is one of engineering judgment. But such judgment even now indicates to many consultants -- at least -- that they should order models on their own initiative as working engineering tools. This they are doing -- to sell clients on ideas, as well as to work ideas out in the first place.

For the future -- greater discrimination will be exercised in specifying the kind of detail to be built into the 3-D model. This will depend on the use planned for the model -- whether it will be used for merely checking of design, whether it will be a working tool in creating designs, whether it is intended for use in the field by construction crews, whether it is to be a permanent representation of a plant in the plant engineering staff offices, and/or whether it is to be a display piece for a board of directors' room, for a lobby, or for the public relations people.

These varied, ultimate uses will have to be balanced against the following facts; finer detail requires more time for completing the model; it may mean that the model may not keep up with the design work or with the needs of the constructors in the field. Most important, perhaps, is the fact that finer detail costs a great deal more money.

For example, ready-made scale models of machine tools are relatively cheap and widely available-- making the cost of fabricating plant models comparatively cheap. In modeling of process plants, the model price goes up considerably because of the unique nature of the equipment and construction of each individual plant.

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FOR THE FUTURE: -- there will be more and more compromise between the 2-dimensional and the 3-dimensional scale model. Where the model is a design tool only, and is not meant to be sophisticated enough for display purposes, templates will be used with strings and cardboard strips suspended on pins above the template level. The cardboard strips and the strings can represent overhead and underfloor piping, conveyors, ducting, etc.

This particular compromise technique is already proving good for models of foundries and single-floor installations where there are only one or two levels of concern above or below the principal floor level. The heights of the strings and the strips are not necessarily set to scale, but they do call attention to cross-overs and possible interferences. Where such things are all that is of concern, then a compromise 2-D model works out very well, and it is comparatively inexpensive.

Colored strings can also be used to trace the flow of piece parts through a plant during manufacture. The path of a meandering string may show that material handling costs are unreasonably high; some plants have found handling costs to be as high as 35 percent of the total product cost. Shorten that meandering string on the model, and costs are cut, too.

FOR THE FUTURE: -- models will be called upon to solicit plant design, and particularly layout, advice from trades and shop foremen. They can't comprehend the dozens of foundation, structural, handling systems, ventilation and other drawings that are needed to truly represent a modern plant. As engineers come to realize that these trades and shop people can understand a 3-D model, it will be found advisable -- indeed profitable -- to call upon them. The model will draw out suggestions from the trades and shop people before they are saddled with an actual plant. This is one of those great values accruing from models which is difficult, if not impossible, to evaluate in dollars and cents.

FOR THE FUTURE: -- models will be built in sections, divided by major departments; the total model will be the sum of the department models. The models will be built in sections, first, to allow access for more people to work on the building of the model -- keeping it strictly up to date; second, to make it available for use sooner; and third, to allow more people to work with the model after it is completed.

Another reason for going to models built in sections is that the models themselves are getting bigger. The scales are getting larger. For the future -- look for scales of 3/8 in. to the foot, or even 1/2 in. to the foot, rather than the common 1/4 in. to the foot. There is serious thinking afoot that the added cost of models of larger scale will be wiped out by the cost of drawings thereby eliminated. The drawings will be eliminated because designers are thinking of scaling right from the model when erecting field-fabricated units. There is thinking that the 1/2 in. to the foot scale will permit scaling from the model in the field.

FOR THE FUTURE: -- designers will outline a structure and set in place those major equipment or process lines which, of necessity, determine the principal layout characteristics of a plant. Then, they will make up a model. On the model, they will finalize equipment placement, piping, handling systems, conduit, duct, etc. From the model will be made final drawings; the first line on paper will be the last line. For the future -- the 3-D model will be more widely accepted as a working tool for the engineer during original design rather than a mere checking tool for use only after design is final.

Already one of the largest, if not the largest, consulting firms does not hesitate to spend some $5000 or more on a model for a $500,000 job. If the design is essentially a repetition of a previous job this is not done; but, a model is seriously

considered whenever something new or unique must be designed and must be sold to a client.

FOR THE FUTURE: -- look for greater utilization of the specialized talents of firms devoted exclusively to the building of models. Model building just does not work in efficiently or economically with manufacturing or consulting establishments. These specialized model builders work faster; they produce more cheaply; they can call on a vaster store of experience in applying techniques; they know what kind of detail is significant as well as what can be left out. More models, on the whole, will probably be built by the specialists in the future.

FOR THE FUTURE: -- There will be a succession of models for a given job. There will be more rough block models to orient the major features of a plan; the order of the scale here might be one inch to 30 feet. Initial block models will be followed by models of successively increasing scale and increasing detail, down to the point where two- and three-inch piping shows. The order of scales will likely get to 1/2 in. to the foot, as mentioned.

Now, look at costs for the future, generalizing to establish an order of magnitude. For a model 1/4 in. to the foot scale, about 1/10 of 1 percent of the total plant cost will buy a satisfactory model. Raising the scale to 3/8 in. to the foot may push the cost of the model as high as 3/10 to 4/10 percent. Choosing another cost basis, consider the final, actual area of the plant, the model cost might than be expressed as perhaps 3 to 6 cents per square foot.

Here are some specific examples: A power plant model may cost $100,000 when the plant itself costs $50,000,000; that's 0.2 percent. A model for an $8,000,000 industrial plant may cost $10,000; that is 0.125 percent.

The model makers will work on an hourly basis (at about $6.00 an hour) for their labor, if that basis is preferred. The most important factor in the cost is the detail put into the model; detail runs up the cost of a model considerably. Consider, though, that a large model with a great deal of piping may cost $10,000; but large alloyed piping may cost $1000 per foot installed. Catch just one interference in such piping, and the model is easily paid out. Furthermore, the costs of production delays and constructions delays are eliminated.

How will all this anticipated use of 3-D models justify itself in the future. First, it must be recognized that a given job cannot be done twice -- with two separate but identically competent staffs working absolutely independent of each other, where one staff uses no model and the other staff uses a 3-D model. Therefore, there is no absolute, side-by-side comparative data available.

Another factor is human nature, -- protective instinct. Human nature works against the admission of errors, especially errors that are only hypothetical. Who will say that he would have made a $3000 error if he had not had the aid of a model?

A vice-president of one of the country's foremost engineering and construction firms will tell you that he considers that no engineer's head is good enough, or big enough, or well-organized enough to hold and index every significant detail of design in plan and in section. Human fallibilities exist in engineers and these must be reckoned with. The proof of the pudding is that this firm uses full 3-D models, the compromise 2-D model, and 2-D template models.

More on savings: It is readily apparent and widely admitted that 3-D models help get controls and instruments in convenient operating positions, particularly in process plants. But who can say how much is really saved by quick access to a valve in case of an emergency?

One of the very best illustrations of savings: a consulting engineering firm called in seven painting contractors to estimate on the basis of conventional drawings the cost of painting a new plant. There was a room with all the drawings laid out on tables and the seven contractors were each called in individually to examine the drawings and quote. Only two of them would bid at all, and those two freely admitted that they had added a 15-percent contingency factor because of ladder problems they could not foresee, and because of other problems they knew were there but could not identify at the moment.

Each of these seven contractors were next led into another room; the same drawings were there, but a 3-D model of the plant was also there -- 1/4 in. to the foot. Then all seven painters estimated on the job. There were no contingency factors in any estimate; the savings in contingency factors eliminated paid for the model.

Another specific example: a group of engineers have said that a model they used in planning the modernization of a 90-acre plant knocked off two to three months in layout time. The model knocked off another two to three months' calendar time in selling the board of directors. This modernization program was estimated to be able to save the company $750,000 a year; that four to six months' time gained saved $200,000 to $300,000. The model ultimately was paid for many times over.

In a production plant, the speed-up of design and construction and the forestalling of delays (by forestalling errors arising in field construction) can mean production of saleable goods sooner. The money tied up in the plant begins earning its way sooner; the head start on the utilization of capital funds can pay for the model.

Perhaps the greatest testimony to the future of the 3-D models is the fact that the great bulk of business coming to the model specialists comes from repeat orders.

But the future is not without problems; first, engineers must learn to think in 3-D. Engineering schools and most of experience teaches engineers to think on the 2-D drafting board. There is some very real initial reluctance by engineers to grapple with the third dimension. The added degree of freedom is often forbidding.

Second, the model must be kept up to date so that actual design and the model itself are abreast of each other. Otherwise, designers become impatient with lagging model making, and they go back to 2-D drawings while they are waiting. In an existing plant, the model must not be allowed to fall behind actual plant changes; otherwise, the relation of the model deteriorates with the model itself.

Third, the use of the model must be scheduled by plan, rather than by mere chance, if it is to serve the office and field effectively. The model must be where needed, because impatience breeds contempt.

Last, and perhaps most important, a major problem exists in that it is difficult to justify an expenditure for a planning tool in the eyes of management. They can see the need and the use of a screwdriver; they can see the need and the use of a drop-hammer; but the value of a planning tool often escapes them. The very newness of models, their metamorphosis from toy to tool, and their intangible values make them particularly hard to sell to a skeptical management.

One firm of consultants successfully sells the use of models on the basis that they -- the consultants -- know just intuitively that a model is justified for a given project. Clients have come to accept the judgment of a consultant, and many times the consultant buys the model on his own when he feels it is justified. He buys it as an acknowledged working tool, almost on the same basis as buying a slide rule.

IN SUMMARY -- FOR THE FUTURE -- models will be used more and more when newness in design is a significant factor. Greater discrimination will be used in selecting the degree of detail to be included on a model. Perhaps more widespread compromise of 2-D and 3-D techniques will be used to bring costs more in line with the model's end uses. Models will permit more consultation in the future with trade and shop people; in the future, these people will participate in design and planning to an extent not now possible. For the future -- models will be planned for construction in section for quicker fabrication and better utilization.

PERHAPS MOST IMPORTANT FOR THE FUTURE: the model will be as much a design tool as the slide rule is today. Design will be born on the model; there will be greater use of specialists in model making; there will be a succession of models as the job progresses.

Perhaps this presentation has gone a bit far afield in some directions; on the other hand, perhaps it has overlooked some salient points. But this has been merely an attempt to take the information available today as a basis for peeking into the future. I hope you will feel some light has been shed in that direction, and I thank you for your attention.

MR. CLOS. Mr. Bergen, Would there be any advantages to setting up a 3-D model of an existing plant?

MR. BERGEN: There definitely are advantages to setting up a 3-D model of an existing plant; the plant today is not what it was yesterday; nor is it what it will be tomorrow or in the more remote future. Every day-to-day change means that you have designed -- in fact -- a new plant. You can very well justify putting a model together of an existing plant; Pullman-Standard has done this and Oldsmobile has been doing this for quite some time.

Of course, the greatest advantage in having a model accrues when planning from scratch; that is, building a model of an existing plant gives you less potential opportunity to use the model simply because the great bulk of the design work has already been done. But this is not to say that building a model of an existing plant will not at all be justified; it can be justified in many cases, particularly where plant layout change is the order of the day.

MR. CLOS: Thank you, Mr. Bergen. We now turn to a gentleman, who in the true engineering spirit is stepping into the breach, here is a job that has to be done, and has to be done for many people, and one that brings us another look into the future. I give you Mr. Robert W. Choate (*) with "Automated Industries of Tomorrow".

MR. CHOATE: Thank you, Mr. Clos. Gentlemen. In a way, the title of my talk implies that I'm going to gaze into my crystal ball and tell you all about the shape of things to come. That's not quite 100% true. I would, however, like to draw your attention to some phases of industry today, where automation really is helping to shape the future. I left my crystal ball back in Detroit, so we'll have to project some slides to illustrate my points. When we think of the future, and wonder what it will bring, we generally can be sure of this: lots of things will change. New ideas and new practices replace the old. One of the major changes in industry today is taking place in the foundry, where shell molding is changing the thinking and practices of everyone who makes, buys or uses castings.

Shell molding is only about twelve years old. It was developed, you may remember, by Johannes Croning in Germany in the early forties and we here in the United States learned about it through Final Report Number 1168, Field Information

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Agency, Technical, U.S. Department of Commerce, dated May 30, 1947.

The basic principle of shell molding is simple -- so simple that we engineers have been wondering, since we heard about it, just why the idea hadn't occurred to us. Anyway, the mechanics of shell molding are simply the application of a mixture of sand and resin on a heated pattern plate. The heat melts the resin, the resin binds the sand into a smooth mold. Then you take a matched pair of these molds, hold them together and pour in molten metal in the proper quantity. Allow the casting to cool and remove from the mold.

In simplest possible terms, that's all there is to shell molding. Actually, nothing is that simple, and certainly not the production of high quality shell molds. It takes a lot of study and a lot of experimenting to learn how to run a shell mold operation - and a lot of equipment, too - to get uniform and dependable results.

Shell molds are from an eighth to three-eighths of an inch thick, and weigh only a fraction of the poundage of a conventional mold. The lightness of the molds makes a tremendous difference throughout the foundry.

To match the efficiency of the shell molds themselves, the machinery that makes the molds has to be outstandingly efficient, too. It must be capable of turning out mold after mold, of uniform thickness, physical characteristics, and surface finish. It must be flexible, so that patterns can be changed easily to conform to production schedules. If it is properly conceived and designed, it can key up the whole shell molding foundry, setting standards of efficient production that will carry through every operation in the establishment.

We at Mechanical Handling Systems are in the business of creating the methods and the machinery for more efficient production through scientific materials handling. We have worked with conventional sand foundries, designing much automatic handling and efficient material flow into them. But we were always limited because of the dependence on mold production by relatively slow, variable and capricious hand labor. There's no point in setting up a high capacity, automatic mold storage and delivery line, for instance, if mold production is not uniform and predictable.

Since there was no such high-production shell mold machine on the market, we designed, engineered and built one. Here it is: SLIDE #1. This 12-station machine is capable of producing 480 molds per hour, and is so automatic that it requires only one man to operate it.

The machine revolves counter-clockwise, with the shell removal station at the far left at the end of the cycle. Each of the 12-stations produces a shell mold with each complete revolution of the machine. Pattern size on the machine we are looking at is 22 x 28 inches. There can be 12 identical patterns on the machine, or twelve different patterns, or any variation in between. Patterns may be changed at any time, without halting production. Now, for the smaller factory, a single station machine - or two or three of them in a battery - will surely prove widely useful. The ideal single station shell mold machine should be, like its big brothers, as completely automatic as possible. It should turn out molds of the same thickness time after time. It should be quick, positive and sure in operation. It should be flexible and adaptable to the needs of changing production schedules.

SLIDE #2. Here is the MHS single-station shell mold machine. It is capable of turning out forty shell molds of average thickness (three-sixteenths to one-quarter inch thick) per hour - the same relative rate as that obtained in the continuous operation of the twelve-station unit which I described earlier. Pattern size is twenty-two by twenty-eight inches, but molds of smaller size can be made by including metal dividers in the pattern plate. The shell mold can then be

broken by hand into two or four sections. And there you have it, gentlemen .... shell molding. That's the "new look" for tomorrow, as seen from the foundry.

Something else we'll see lots more of, is the use of power and free conveyor systems. They will give "freightyard flexibility" to production's main line in the larger plants.

The MHS Power and Free Conveyor is a simple combination of power trolleys, which run on an I-beam in the conventional manner, and load-carrying trolleys which run on an I-beam suspended below the power line and are pushed by the power trolleys. Since the two types of trolleys are not permanently connected, the load-carrying or free trolleys can be switched at will from the power conveyor line onto free lines. Or the power trolleys may be disengaged by simply raising the power line.

Power and free conveyors are advantageous for many types of manufacturing, since the carriers need not be unloaded from start to finish of the operation.

An engine block, for instance, goes on the carrier at the start of line. Assembly operations are completed as the carrier moves along the power conveyor.

It is automatically switched to an open test station on a free line, then returns to the power line which carries it to storage or shipping -- or into repair and out again, if it fails to pass inspection. Although the engine goes from power line to free line several times in the course of manufacture, it rides the same carrier all the way, requiring no manual transfer or lifting from the beginning of assembly to the finished unit.

Selector systems, used with the switches illustrated in this slide, will classify loads, switching them automatically to a pre-selected line or lines. Stations can be selected by a flagging system on carriers, and the work load automatically dispatched to a predetermined station or stations.

One example of this is in an automobile tire plant, where tires are made for service -- in order words, for retail sale in stores and service stations. Within the plant, they are set up to make a total of nearly 150 different kinds of tires. They vary in size, type, tread, grade and brand name.

To maintain steady production, each bag-and-carcass assembly must reach its own vulcanizing mold at the right time. With 150 kinds of tires, that calls for a lot of system. Here's how we worked it out: The backbone of it all is two overhead monorail systems, which run throughout the plant. One system consists of tractors pulling trains of 10 to 40 carriers, each carrier holding a bagged carcass.

The other is an upside-down lift truck, which runs ... self-powered .. on a monorail.

SLIDE #3 -- In this view, we see the forks of the truck approaching the carcass. The weight of the carcass on the roller section has automatically signalled the tractor to stop and pick it up. The next series of slides shows the forks ... entering the carcass ... lifting it to clear equipment on the floor ... and conveying the carcass in the elevated position. Here we see the truck entering an elevator to go, automatically, to another floor. Now, here is the tractor which pulls the train through a pre-determined path. Here is the "magic brain", the Signatrol control head; which guides the train on its journey through the many manufacturing operations. And here's the inside of the control head. It is a maze of electrical equipment, including telephone relays and rectifiers. Routing information is dialed into them at the beginning of the trip. This information will guide the

tractor -- automatically -- throughout its complicated trip. Once placed on the carrier, the tire carcass is routed, through a bus-bar system. A signal is given at each station. If the signal is right, the control head responds by operating a switch to a side track which will lead to any one of several hundred stations. This shows a switch box and operating button in the bus system. At points like this, the Signatrol control head determines whether the train will continue in a straight line, or will be switched off to the left, in this case. These carriers will go anywhere. Guided by the memory of its "magic brain", the train takes the carcasses to their proper vulcanizing presses. This view shows the train arriving at a battery of these presses.

SLIDE #13 - And now, the train leaves the vulcanizing presses with its load of finished tires. Still guided by the Signatrol "magic brain", it will take the tires to their proper storage bays -- automatically. It's all automatic. Selection of the "green" carcass ... placing it at the right vulcanizing press .. at the right time to maintain steady production ... delivering the finished tire to any one of the storage bays. The flexibility of this kind of system is nearly limitless.

It's a safe bet that automation will continue to benefit us in the field of chemistry. The automatic plant for chemical formulation and production is not only foreseeable -- it's here! There are many fine examples of this kind of push-button production in chemistry. Here's one: SLIDE #18. In this plant, the chemist in charge is really the boss! Instrument settings, electronic controls and automatic instructions govern the continuous, automatic production here. Rate of flow, compounding of ingredients, timing and temperature control are easily managed by the chemist in the push-button plant. He has steam, hot water and refrigerated water available to him. Automatic valves control temperatures in compounding. At the far left of this slide, we see the product supply line, bringing the product, under pressure, to the bottom of the processing tank. SLIDE #20. Here are the water tanks, source of the hot and refrigerated water, as well as the conditioned, pure water, automatically metered for the dispersions. Heating and cooling is accomplished in the two tanks at the right. At the left, the tanks are shown which produce absolutely pure, conditioned water.

SLIDE #21. This automatic scale car moves up or down the aisle, between processing tanks and dispersion tanks shown at the right. The scale on the car weighs the dispersion ingredients, automatically recording both weight and type, then moves over to the processing tank, discharging its accurately weighed and recorded load.

SLIDE #24.....and finally, from the process tanks, the chemical compound is discharged by hose into molds to complete the process. Chemical compounding ... continuous production ... automatically. And all of this is under the supervision of just one man. It's another sign of the times to come.

Great strides are being made, in the automatic transfer of work from one operation to another. A good example of this can best be shown by this blueprint reproduction.

SLIDE #26. This is a portion of a press line over two hundred feet long. It could be set up to produce units such as tubs or tanks, by drawing and forming. Now, if we can follow the numbers on the print, we will see how the work moves smoothly, automatically from operation to operation, along the direction of the arrow (4). When presses 1, 2 etc., are up, they close a circuit by limit switches, one to a press. The parts (3) are to be moved one space, from left to right, as we see it on the slide. These parts rest on rails (5) which are level with dies in the presses. It is important that we remember that all motions are produced by limit switch action at the end of the preceding motions. Here is the cycle:

SLIDE #29. Jaws (6) are moved against the part by air cylinder (7), through rack and pinions. Also, jaws (8) are moved against parts resting on rails (5) by air cylinder (9). We can see that better in section A-A. All these jaws are rubber lined.

SLIDE #30. Next, we see the transfer device, which is moved to our right by an air cylinder (10 in the elevation). The transfer dolly runs on tracks, which have slight depressions for the wheels when the dolly is in either end position. During motion, the dolly is thus raised to lift the parts off the tracks or dies. The cycle is complete when the jaws open and transfer dolly retracts to "start" position.

Incidentally, these transfer dollies are mounted on wheels, running on cross tracks for moving the transfer device toward the top of our slide, here. This gets it out of the line for die changing or other maintenance.

SLIDE #32. Here we see the complete line. We've broken it up into sections, to get it on one slide. Installed, of course, everything would be in line. This slide shows us the blanking, first and second drawing, and the washer and blow-off stages. Increments of motion between each two presses may differ from that at other points, depending on the plant layout. The presses may be arranged so that they will automatically produce the next press stroke after each transfer motion. Selector push buttons at each press permit manual control when needed. Now, we see the roll form machine (11) which receives tubs from position (12). Arms (14) with rubber jaws grip the part and swing it to position (13) around axis (15). The part is released now, and the arms go straight up. The part is in the upside-down position. From here, the part is moved to point (17) ... on machine (16) ... by arms (18), and is right side up again. From (17) the part is moved to position (19) by arms (20) in the same fashion. Now the part is upside down, and moves on a slat conveyor to the next operation.

I hope you were able to bear with me during all that maneuvering from number to number. The big point to remember is that a lot of things happened automatically. Three draws ... washing ... blow-off ... piercing and trimming of the tub bottom ... trimming of the top ... roll-forming the top ... rolling in the bottom bead ... piercing the top ... flattening the sides ... welding the ferrules ... welding top and bottom brackets. That's what the blueprint represents. It also represents 100 tub assemblies per hour, with only three operators. Industry will see more and more production of this type. This, too, is a strong indication of the way we will be doing things in the years to come.

I believe many of you had the pleasure of making the tour through the G.E. plant yesterday. I hope you had the chance to see how wiring harnesses are built for their automatic washing machines. It's a piece of real organization ... to which my company had the privilege of making major contributions. It's a matter of bringing the work to the operator, by monorail conveyor and carriers.

Wire reels are kept in storage and are brought to the wire cutting machines by overhead powered monorail. As supplies of wire are cut, they are placed, in bundles, on specially designed carriers traveling on overhead conveyor. The carriers move around to operators who remove the bundles from the conveyor, attach terminals to the wires, and replace the bundles on the conveyor. Attachment of switchette assembly, and necessary soldering is done by other operations, who take bundles of raw wire off the conveyor, perform their appointed jobs, and replace the wire bundles back on the conveyor. Bundles of wire, ready for the assembly boards, now approach another conveyor, operating parallel to the wiresupply conveyor. This is the assembly conveyor, and it carries pattern boards which carry pegs and diagrams to guide

the operators in assembling the harness. Operators, seated at this assembly conveyors, draw their stocks of wires from the wire supply overhead conveyor, and since the 70 wires are always traveling the conveyor in orderly and instantly available inventory, only a small supply is at the assembly station at any time, and the operation is uncluttered and free of confusion. These pattern boards, or peg boards, or matrices, whatever you'd like to call them, look like artist's or draftsman's boards, moving at just the right height. Each operator has only a part of the assembly to build, and as it moves around the conveyor, the harness grows easily, smoothly and efficiently until at the final station it is inspected and the okayed assembly is placed in an individual carrier on an overhead conveyor bound for the next step in the electrical components assembly.

We may find automation extending into the field of retailing, more and more. Let's theorize about a specialized form of retailing -- the mail order business.

Thousands of orders arrive every day, for a wide variety of items, chosen from a catalog. While the average order may be for less than half-a-dozen items, let's make it tough. Let's say that an order arrives for 40 different things -- tooth brushes, hardware items, floor mats, and so forth. A girl breaks down the original order into 40 different orders ... which must be routed to 40 different departments. along with a time of delivery to a conveyor system or chute. Within the different departments, people gather the items, make them ready for the conveyor. When the specified time arrives, the 40 items land, all together, on collection tables. Fine, so far, But, they are mingled with other orders and must be hand-sorted to separate and re-group them for shipment.

Now, here would be a better way. Upon receipt of the 40-item order, the girl transfers the information to a punched card. The card is attached to an empty container, on a moving conveyor line. The holes in the card determine which departments the contrainer will stop in .. and which they will pass through. This could be done electronically, through a switching system. In any event, the container winds up with the entire order, in the shipping department. The order has been processed through automation. It has been mechanically organized, eliminating most of the manual work, and much of the supervision. Complete systematizing of this sort is a real and complete service, rather than a partial system of "trouble shooting".

Now, there's another fellow, in a completely different field of activity, whom we must not forget. He's the farmer. God bless him, and we all depend on him ... just as he depends on the administration in Washington. Farming is a big business, nowadays, and promises to be even bigger. The farmer has mechanized his operation, through the years, to till his fields, fertilize them, sow and harvest them. Today, he is moving into an area where even more of his operation is being streamlined. Believe it or not, he now can feed his cattle by pushing a button in the living room of the farm house. Here's how it works: The silo is equipped with an unloader, which rides the top level of silage. It acts somewhat like a rotary scraper, taking silage off the top. A conveyor belt carries the silage to the feeding trough as needed. By electrical controls, the farmer actually can feed his cows the push-button way. Or, if he's too tired, his wife can quickly do this chore without even interrupting her favorite TV program.

By necessity, the dairy farming business is going toward mass production. Successful dairy farming involves large herds of cattle, and vast quantities of food. The cows are kept in one building all of the time. Not just for days, but for most of their milk-producing life. The cows are fed automatically, by conveyor, as they stand in their individual stalls. Their feed is a fortified corn meal, which is freshly ground and compounded from the raw ingredients, including both the kernel and the

cob of corn. These are contained in bins in the feed storage house. Conveyors also keep the barn clean. Body wastes from the cattle are carried by conveyor to tanks or trucks, for storage or transportation to the fields as fertilizer for next year's feed crop. About the only time the cow gets any exercise is when she is led to the milking parlor where she is milked -- you guessed it -- automatically. So, the farmer, too, has a stake in our automated future. He is one of many. All of us can look for a higher and more pleasant standard of living through the things automation can bring us. The automatic production of goods ... the push-button factory ... better chemicals through exact and automatic controls ... mechanization on the farm...in the production plant, in getting goods to market. That's the shape of the future, gentlemen. And we engineers are the boys who will play key roles in bringing it about.

MR. CIOS: Thank you, Mr. Choate. Another section of humanity that you engineers keep on their toes are the newspeople. Something new to write about every day, every time you gentlemen get together. The last speaker, to me, is not the most important speaker that we have had, but I think that what he is going to say to us is entirely new from what you have heard this morning. He knows whereof he speaks, when he brings you -- "Management Control - A New Field for The Industrial Engineer". -- Dr. Alex Rathe.

DR. RATHE (*): Mr. Cios, Fellow Members, Gentlemen. That was very flattering. I am not so certain that I could define, to the satisfaction of everyone in this audience, just what an "Industrial Engineer" is or what he does. Let me try, however, to submit to you a description of one of the newest fields in Industrial Engineering - Management Control - and to attempt to briefly sketch just what it means. I would also like to try to explain how we Industrial Engineers are affected by top management's intense interest in the development of this area of managerial endeavor.

THE MANAGEMENT CYCLE: In over-simplification, "management' means the direction of any activity. The manager sees to it that things get done; he makes things happen. And he does all this through others, through the work of those he manages. This mission implies at once the futility to attack a problem without a carefully preconceived plan so that we can be certain we will reach our objectives in the best way. This first segment of managerial activity is often called "Planning". It forms the basis of the second sector, "Operations", which is guided by the plans prepared in advance. And finally there is the third area of management endeavor which, most unfortunately, has been termed "Control". In this segment, the task is one of deliberately reviewing how operations conform to plans and of drawing conclusions, from these results, on how future plans might be improved on the strength of current operating experience. Three elements - planning, operating and control - form a cycle, the management cycle. The first and third are often called "Management Control"; and it is this meaning of the word which underlies these remarks.

The management cycle is nothing new nor is it something special to business. It is a phenomenon of life which can be observed wherever there is human activity. Take the government, for instance. Its planning agency is the Legislature; the Executive Branch is charged with operations; and the Courts are entrusted with judicial review. The exact location of the demarcation lines between these three agencies appears at times to be questioned by some. The reason for this may well lie in the fact that the scope and responsibilities of all three elements - but especially of planning and control -- are not always clearly definable.

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The most important feature of the management cycle is, however, not the specific boundaries between its three elements; it is the fact that we deal here with a cycle, with a closed loop - if matters are arranged properly - in the engineering meaning of this term. The key in this circuit thus becomes feedback with its determined task to close the loop so as to guarantee the utilization of new knowledge as the prerequisite for progress. Feedback permits us, systematically and continually, to profit from experience - in engineering as well as in management.

Here then is the first opportunity for the Industrial Engineer to attempt an ever greater utilization of the body of knowledge in mechanical and electrical engineering, in servos and related fields, and to do so in the service of management problems. A brilliant path has been opened up by Dr. Norbert Wiener and his study of Cybernetics. It spotlights, as few - if any - other developments in our field do, the constant devotion which the Industrial Engineer has to display to areas which border his own, such as psychology and many other sectors of the living sciences, in addition to his firm anchor point in the technical science.

Other possibilities for great engineering contributions in this field of Management Control will suggest themselves readily when we take a look at the first and third elements of this management cycle of planning - operations - control.

PLANNING: Planning means looking ahead; it spells thinking about operations in advance. It determines what should take place. It charts the course, prepares for action. It is the antithesis of speculation or hesitation; of playing by ear or flying by the seats of our pants. In this rather vast domain, planning proceeds in two major steps: ... it sets goals and ... it designs the approach to these targets. Progressive management and progressive Industrial Engineers are fully familiar with the many planning techniques. For the first step - establishment of goals - there are: (1) ECONOMIC FORECASTING AND MARKET RESEARCH: Both endeavor to peer into the future and to bring knowledge of things which are in the offing; (2) OPERATING PLANS AND PROGRAMS: They specify the exact action which is required, in every nook and corner of an enterprise, to reach the goals which have been established.

For the second step - design of the approach to the target - we can list quickly: (1) organization which erects the framework within which operations will be carried on; it assigns specific people to specific tasks; (2) policies; they lay down broad rules and establish general guides for all activities; (3) methods, procedures and systems; this threesome provides detailed operating instructions for factory floor, clerical work or any other tasks; (4) standards provide operational yardsticks and set up criteria for time, quantity, quality, cost and many other significant aspects; (5) schedules furnish time tables by which individual operations are dovetailed; (6) budgets, finally, express the operating programs in terms of the most common denominator, namely money. Little needs to be said about any of these techniques before an audience such as this because most of them represent recognized key areas of Industrial Engineering. We can sum up this planning work by stating that it is concerned with what has to be done in the future. Control, on the other hand, looks at what is going on right now.

CONTROL: If planning looks ahead, then control looks back, examining the tracks made in operations. It determines what is taking place. It thinks out the lessons of actual operations and watches how the existing plans are being realized. It is the extreme opposite of guess or opinion or hunch.

In further analogy to planning, control also may be looked upon as having two major steps: First, it measures actual accomplishments and secondly, it points out deviations from plans, ferrets out their reasons and develops desirable adjustment for

use in future planning.

Before taking a closer look at the available techniques, a word should be devoted to the existing terminology. I have adhered here to the classical phraseology and used the word which many abhor as deeply as I do, namely, "control". The main reason for this attitude is the fact that "control" has the connotation of power. If one controls votes, this power influences people; if one controls his temper, this power suppresses; if one has his car under control, he operates it smoothly and carefully. Is any of these meanings what business intends to convey by the word "control"? Of course not. Then why continue to use it?

For a few years now, I have preferred the term "review"; others have selected "appraisal", "measurement", "evaluation", etc. In any case, the significant point is that there is general agreement upon the meaning of the word. And as far as the management cycle is concerned, control (or review) techniques aim, as stated, at performance measurement to detect deviations from plans and at appraising these findings to recommend improvements.

For the first portion of the control task, a selection of the more generally employed measuring techniques would comprise: (1) general and cost accounting which provide data on the financial aspects of operations; (2) production control which gives information on the quantitative aspects of output (in the factory or in any other type of work); (3) inspection which supplies qualitative indicators of output; (4) personnel measures which report on the human element - as an individual or in groups; (5) management control data which furnish additional performance measures not generated by the techniques mentioned above.

The tool kit of techniques for the second part of control work, that of appraisal, is much scantier; it includes: (1) statistical methods which organize and summarize data into more compact and meaningful form; (2) quality control which interprets inspection data and recommends remedies for quality shortcomings; (3) financial audits which perform the same task in the accounting area; (4) management surveys and studies which should do so in the full domain of managerial activity.

In comparison to planning, these techniques represent a much smaller assortment; and fewer are in the field of Industrial Engineering.

THE INDUSTRIAL ENGINEER - MAINSTAY OF MANAGEMENT IN PLANNING AND CONTROL. Yet despite this, the Industrial Engineer plays the key role in the areas of planning and control. All of his work takes place in these two out of the three segments of the management cycle. If his tasks take him into operations, he may do a good job in that sector as well but that takes him out of the legitimate engineering realm into that of the manager.

Another interesting recognition is this. The greatest weakness of the management cycle is the Industrial Engineer's greatest strength. May I illustrate this by an analog. The twin tasks of planning and control may be regarded as the "executive's instrument panel"(1); in this concept, planning is seen as the dial and control as the indicator hand.

For the dial to be fully useful, it has to be calibrated. And this is a pure engineering task because it means the establishment of yardsticks; it demands the development of standards. And setting standards is the very problem that brought about the birth of what we now call the Industrial (or the Management) Engineer.

(1) Rathe, Alex W., "How to set up Management Controls"; Funk & Wagnalls Company; New York; 1948.

Providing management with reliable standards is one of its most pressing tasks because in so many areas, it is really more a 'case of the missing yardsticks'. To wit, we do not yet know how to set reliable standards for creative work - say, research results or copy writing --, in the human field - for instance, morale or initiative of executives --, and in many other 'intangible' areas. They will remain 'intangible' until the Industrial Engineer puts his ingenuity to work on this great challenge before his profession to make possible the measurement of the as yet unmeasurable.

There are just too many areas in which we can not yet measure results and in which we thus lack clear-cut facts. We need a yardstick first before we can unquivocally designate how much to expect. Once we have one, we can establish a standard on the basis of which the planning dial could be calibrated.

When we can not measure something factually, we have to rely upon opinion. This is synonymous with saying that we have to expect disagreement because opinions differ when different people are involved. As a matter of fact, opinions are likely to be as varied as the people who state them. This is borne out, for example, by the varying reactions which the final award of the Miss America prize provokes each year; and this happens to be a case in which, at least partially, measurement is possible.

Before the Industrial Engineer ventures into unexplored territory in his mission to develop yardsticks where they do not as yet exist, he has a wide area to cover in which current measuring rods are not fully reliable. Let's think of one of the key fields of Industrial Engineering - work measurement. In most cases, we use time to measure work; and we do not need the full complement of our engineering knowledge to realize that there can be a world of difference between "time" and "work".

Lest I be accused to single out just our field for criticism of existing weaknesses, may I suggest a glimpse into neighboring territories, say Economics. Take the meaning of this wonderful invention, the dollar. We use the same 'standard' for two entirely different purposes -for measuring economic as well as monetary value. These are two different items because, through the passage of time, the "purchasing power" of the money changes.

This is why subsequent dollar figures on, say, the balance sheet actually use different yardsticks: "Cash" is gauged in its current value while the next line on the statement, "equipment", is measured by dollars with the purchasing power they had years ago when these items were bought; when we reach "inventories", we have to resort to a completely artificial valuation system ("fifo", "lifo", and many others), in an attempt to compensate for the distortions which variances in purchasing power cause all the way through every phase of economic activity.

Much could be said about many other possible contributions to Management Control by the Industrial Engineer in his task to bolster the arsenal of techniques through substituting hunch with facts, and guess with figures by putting his engineering knowledge to work in the service of management. The ever-increasing use of statistical and mathematical methodology is a case in point. Operations research, linear programming, application of game and information theory and many other areas could be cited in support of this contention.

Each merits a paper - or a collection of papers - because of its potential usefulness in this just beginning campaign to push the borders of the art of management back another inch through engineering contributions. For the purposes of this brief survey, I would like to dwell however only for another moment upon the previous point, namely the engineer's age-old task to develop standards.

This makes it mandatory for us not only to design them for their accuracy, validity, and reliability but, above all, for their usefulness in practice. This then is the second - and a tremendous - challenge to the imagination of our profession: To provide more and more useful facts for management.

Facts are the foundation of any science. They are the most common building stone of all engineering work. To provide them in the field of management, has proved to those of us why have been engaged in this area, as a most challenging and rewarding assignment. It will once again bring about another engineering contribution to the practicing executive which is bound to be of lasting significance. This is so because if we do not have facts, if we allow ourselves to be governed by opinion where it is possible to obtain facts, we shall - as Gantt said more than a generation ago - lose in our competition with those who base their actions on facts.

FIFTH SESSION: Friday, May 7, 1954

Theme: "LOOKING TO THE FUTURE"
Critiques - General Summary and Conclusions

MR. CLOS: We are indeed indebted to Dr. Rathe for upholding my introduction of him. I can only say Doctor, that I too have learned a little bit about semantics out of this very delightful and very informative and valuable presentation. Thanks to the understanding of Dr. Rathe, we are now back on schedule. As for the program - the Critique should follow. I am very frankly a little too modest to set myself as one who is capable of making that critique but the passing hours have left several impressions with me, and reviewing the speakers very rapidly, I would say that when Mr. Freitag stood up to guide us into Tomorrow, he set the very keynote which Dr. Rathe so eminently and successfully closed on, which was that the Engineer has the Challenge, and he should bring to it the vision, the capability and the perseverance to the solution of the problem. It was evident in his good company's attack on a problem not of today, but of yesterday, and which will be increasingly pertinent tomorrow. One of the most significant things that occurred to me when Mr. Freitag spoke, was the sentence in which he said that, "Engineers all over the world were looking at what was being done here in America by a little group of you men." I mentioned in my prologue, that you as engineers were diplomats. There you have it - you displace distrust with understanding, and when you give (and it did not have to be ECA, but in this case you are giving of your knowledge of yourself) you are giving of yourself, you are literally acting as diplomats, bridging the misunderstandings. When Mr. Bergen spoke, it seemed to me that some of the techniques that were evolving in the use of 2-D, 3-D, 2-D-3-D, and pure 2-D template, the use of models, was quite a commentary on the once again, the one to one relationship that I mentioned in my prologue, because he spoke of the foreman level, and without casting amy aspersions on individual mentalities, or lack of certain opportunities, educationally, I think that he was going through to say that this, we can feel and share together, because I have cast into a definite touchable mold, my dreams, my ideas, and you as the workman, I must now depend on. There to me was a deep significance of what we call 3-D. Being able to touch and feel something communally, so that together we can make something out of it. I was much interested as your observer to listen to Mr. Schultz, and I am glad that he touched on everything from something that happened in Germany, and as he said almost inconceivably simple, just a very few years ago, to my lady's contented cow, because once again, he was threading the needle with the same color yarn. It was rather significant to me that he should wind up on the farm, because there is where I think one of our greatest problems may be. News items recently set a population of four billions to contend with. Here you industrial engineers, now, are starting to provide for that contingency, to greater utilization of what is and has been a laughing stock of cartoonists. I come to Dr. Rathe now, because he struck to me, the very keynote of it all. I know that he spoke to you from his heart, and from experience and from sharing of one of the greatest things possible, which is that of a teacher to a student. I knew of one of the most successful men in America who dreamed of the day that he could retire to devote his life to teaching. That he thought would be reaching the top of the goal, but what Dr. Rathe said to me that was so deeply significant was, that concerning semantics, and I bring it now to his word of "Controls." Perhaps I close, on the very theme on which I opened, this looking into the future, this resolving it into a prescription personal, the privilege of responsibility, on a one-to-one basis, and I give to Dr. Rathe another definition, semantically of control, applicable only by you, the Industrial Engineers, for foreseeing a world population of four billions, control - an industrial engineer definition, through your individual efforts, a containment of the unpredictable future's frightful possibilities. Thank you, Gentlemen.

MR. CLOS: We have a very brief period for questions, as I know that these distinguished gentlemen can give you the answers that you might like. Are there any questions for any of the gentlemen?

One for Mr. Freitag: "Did Toronto, Canada consider the Speed Walk Conveyor before installing their subway?" Mr. Freitag - you are on the spot.

MR. FREITAG: Toronto, Canada started their subway many years ago, and if I recall correctly, actual construction was started back, or the plans at least were being drawn back around 1947 or 1948, which is at the very beginning of our work of testing and designing models, etc., for the Speed Walk System, so I would say that I don't think that Toronto did consider the use of the passenger conveyor system. We might mention here, as a continuation of that question - any cities like for example, Montreal, or any city which is very anxious to get a subway installed, San Francisco, and Cleveland, are immensely interested in the possibility of passenger conveyors.

MR. CLOS: Mr. Bergen - "Would there by any advantages to setting up a 3-D model of an existing plant?"

MR. BERGEN: There definitely are advantages to setting up a 3-D model of an existing plant, since the plant today is not what it was yesterday, nor is it what it will be tomorrow or in the future. A stagnant plant is not making any progress, and for the future planning, in fact every change means that you have a new plant, and you can very well often justify putting a model together of an existing plant. I heard yesterday, if I am correct in remembering that Pullman Standard has done this, Oldsmobile has done this, but it is, of course, apparent that the greatest growth of a plant is the reason for its first existance in the world, and the greatest advantage is the planning from scratch, to the first day of the real existence of the plant. That is to say, building a model of an existing plant, will give you less service, than if you were building from scratch to a new plant, but it is not to say that building a model of an existing plant will not at all be justified. It will be justified in many cases, particularly where change is the order of the day.

MR. CLOS: Dr. Rathe, I have a question for you. "Will your remarks be reproduced verbatim in the proceedings? and then there is this post scrip - "If not, can I get it down town?" ---

DR. RATHE: That is a beautiful question, and I am perfectly delighted to say this, that the Northeastern delegation, at its full strength, planned its attendance at the convention so well, that they walked out thirty seconds before I started to talk, and came back a few minutes after I was through - and I am delighted to hear this question, and I thank you, sir. The answer to the second part, "Can I get it down town?" No - and the answer to the first part - I haven't the slightest idea. So you see, planning and control is not always factual.

MR. CLOS: Well, I know that the gentleman who asked this question will be happy, for I was thinking of the same thing myself, and after asking, my understandings are, that the talks will be reproduced, and in the proceedings, and therefore that answers that question. I do want to thank Mr. Freitag, Mr. Schultz, Mr. Bergen, and Dr. Rathe, and you gentlemen, for a very interesting session.

WELCOME TO LOUISVILLE LUNCHEON: Wednesday, May 5, 1954.
Presiding Officer: Mr. Roy B. Davis, Host Chapter Chairman; also Sales Engineer, Alemite Co., Louisville, Kentucky.
Speaker: Mr. Archie P. Cochran, President, Louisville Chamber of Commerce; also, President, Cochran Foil Company, Louisville, Kentucky.

ADDRESS: Welcome to Louisville. MR. COCHRAN: Members of the American Institute of Industrial Engineers and guests, Mr. Derry was very brave to invite me to make a talk. I might qualify (and I think I do) of a manufacturer of aluminum, or maybe as an industrial, but not as a speaker, that is not my forte. I have come here today to introduce the film the Louisville Story. Before you see this film, which pictures present-day Louisville - a big city of nearly half a million, and still growing vigorously - I want to tell you just briefly of its beginnings and formative years. Louisville was founded in 1780, on Corn Island, which used to be at the foot of what is now Fourth Street (our main shopping street), when George Rogers Clark brought twenty families here. This was the first permanent settlement. The new town was named in honor of Louis XVI, King of France, whose country had been so helpful to our young nation in its recent struggle for independence. Louisville was a natural site for a city, being situated at the Falls of the Ohio River. Rivers were the main arteries of traffic in those days, much more convenient transportation than overland through the wilderness on horseback and by wagon. With the Louisiana Purchase in 1803, there was further impetus for travel to the West - and there was in increase in river travel by flatboat and barge. The Falls of the Ohio, with their drop of 30 feet in less than two miles, necessitated unloading, portage, and reloading of cargoes at that point - and a community grew up beside the Falls to serve these needs.

The first steamboat, "The Orleans" came here in 1811, and caused as much panic as we are having now over the H-Bomb. Those unsophisticated settlers thought the end of the world was coming. And in fact, a new age was ushered in with the advent of the steamboat. A canal was built to circumvent the Falls, and traffic increased tremendously. The wharf at Louisville was a very busy and fascinating place. Louisville was really on its way as a thriving and prosperous town. The Civil War was another historical event which had a great economic impact on the growth of Louisville. The State of Kentucky, by one vote, did not secede, and so Louisville was neutral, officially, though feeling ran high and families were divided in their sympathies. Louisville was the Switzerland of the Civil War - and prospered greatly.

Louisville is still a river town. For the River, with its abundant water supply, providing also cheap hydroelectric power, as well as cheap transportation, is still our most important single asset. It has been an important reason for much new industry moving to Louisville. A great many large national firms established factories here during the second World War, and many of them stayed on, while more are coming here all the time. These are in addition to such important native industries as tobacco and whiskey. And we are having a renaissance in river transportation. You would be amazed to see it if you were to count the number of barges passing by our busy waterfront today. Today Louisville could almost be called a boom town. We have a very vital Chamber of Commerce here, and are proud of our city and its growth. But now we have reached such a size that we are more interested in keeping Louisville the very pleasant place to live which it is, than in having further growth at this time. We want to absorb what we have, improve our facilities, our educational and cultural and recreational activities, our parks and playgrounds, schools and hospitals. We want to solve some of the problems incident to a growing city - traffic, housing, slums, air pollution. We are dreaming, and working out big dreams and large scale plans for the area, so that all the people, native and newcomer, who work in our flourishing businesses and commercial establishments and our various industries, will agree that Louisville is a well ordered city, a pleasant place in which to live and bring up their families. In other words, our prime concern today is not "bigger" but "better." Now I would like to show you on film "The Louisville Story".....

VITALITY BANQUET: Thursday, May 6, 1954.
Presiding Officer: Mr. Dean Sorensen, President, Host Chapter, A.I.I.E., also Supervisor of Management Services, Ernst & Ernst, Louisville, Kentucky.
Speaker: Our Lordship, Major Bates, Author and Lecturer, Affiliated Press, London, England.

MR. SORENSEN: You probably noticed the hurried and worried actions of our National Convention Chairman (Steve Derry) and our Host Chapter Chairman (Roy Davis) this afternoon. Well, I must let you in on a secret. Mr. Arthur Briese, President of the Hot and Cold Breeze, Ltd., Hot Springs, Arkansas, was scheduled to speak at this banquet this evening. At noon we received word that he missed the plane at Colorado Springs and could not possibly make it in time for the banquet.

Dr. Vinsel came to our rescue the last minute. He commandeered a guest at the Pendennis Club to substitute for Mr. Briese. This friend graciously consented to give us his views about America. He is here in America, fresh from England and visiting our country for the first time. I understand that the purpose of his visit to Louisville is to gather data for his forthcoming book - "So This Is America." Ladies and gentlemen, thanks to Dr. Vinsel, I am delighted to present Major Bates----------

MAJOR BATES: Mr. President, Mr. Toastmaster, Ladies and Gentlemen: perhaps I should have said "Mr. Roastmaster, Ladies and Gentlemen." If I understood Mr. Sorensen correctly, he intimated that if you give an Englishman a dinner, up comes a good speech. Well, I'm not so sure but that when an Englishman has an American Industrial Engineer introduce him, up comes a good dinner. (Laughter). I noticed, for example, that Dean ate rather heartily himself here tonight, and some American Toastmasters are very much like Scotch bagpipes - they make the most noise when their bellies are full - and his certainly is.

When I sailed from Southampton a few short weeks ago, my friends told me they should be praying for me constantly while I was in America, that I might be delivered, not from my traducers, but from my intro-ducers. Shall I give him the other barrel as well? (Shouts of "yes, give it to him!") Very well, I recall learning as a lad at Eton many, many years ago that all Gaul was divided into three parts; I've often wondered what became of those three parts - tonight, ladies and gentlemen, I have the answer to that question. (Are you still there?)

Still, for all that, it is a great delight for me to be here tonight and to meet with this charming and delightful, and shall I say democratic and thoroughly informal group of American ladies and gentlemen and to observe the rather screwy manner in which you introduce your speakers and carry on at your conventions. It is a delight for more reasons than one. In the first place, I have been greatly edified and enlightened by the numerous visits I have had with many of the gentlemen, and some of the ladies, preceding the dinner. I have been delightfully entertained by the program that has been presented here tonight - (up to this point) - and I have been furiously making notes for the new book "SO THIS IS AMERICA!" Many of them I probably shan't use here - but Mr. Sorensen has expressed some doubt as to whether he wanted to pay - what did he say, three what? - Oh, yes, three bucks for a copy. Well, if I should stay another three weeks in America, as I am certainly hoping to do, I'm afraid I'll have so much material that SO THIS IS AMERICA will have to come out in two volumes instead of one - and that will cost Mr. Sorensen SIX bucks. (Laughter.)

In spite of my temporary apprehension when I was invited in such a hurried manner - when Mr. Vinsel came rushing to me in great distress saying the Chairman was in a quandary, the speaker had missed his plane and would I be so good as to come and "hit it in the pinches" - (or what was it) - O, "pinch hit for him." At any rate,

I'm glad that I came, and especially because Mr. Sorensen has explained to me that this group of ladies and gentlemen, and especially the engineers, represent the cream of the civic life, the culture and the intelligentsia of the engineering profession in Kentucky..... God help Kentucky! (Laughter) ....and indeed, your good President, my new friend, Colonel Groseclose has gone further than that, for during the dinner he said, "Major Bates, this group is the flower of America," and he added, "We certainly have some daisies in here tonight." Of course, we all know that nature has provided that every flower garden has some weeds in it. But speaking of daisies, and speaking of flowers, I can't let this occasion pass without expressing my unqualified delight with those real flowers of America, the ladies of America. I think you have in your country the most delightful ladies of ANY country on the face of the earth, not even excepting my own country....(Applause). (That seemed to carry unanimously, Mr. President.) But I suppose if in England one should get together such a group of ladies and gentlemen as this, and find among them such a high percentage of pulchritude, and charm, and beauty as I see about me in this room, I should never have come to America in the first place. But of course one knows before coming to the States of the perfectly delightful character of the American ladies. One quite frequently meets American ladies in my own country and one knows how thoroughly devastating the American ladies are. There is no defense against them. One might wish, however, that in the future you American engineers would keep your American ladies at home in your own country....they have such a tendency to change the whole trend of British Empire. They sabotage our Royalty, they steal our Kings, and there is nothing we can do about it. (Laughter). However, things are getting better with us in that respect, I must say, because Mrs. Roosevelt was not so successful when she visited us later (laughter and applause).

There is something about the Americans that sort of grips one; it's this easy laughter of the Americans, the friendliness of the Americans, the warmth of the handclasp with which one is met, that makes one feel so at home. I am delighted to have come. A few moments after I had been drawn into this assignment, and the chairman had presumably told your president about it, my telephone rang in the Seelbach Hotel. Mr. Groseclose introduced himself and said he was delighted to know that I had consented to come, and he would like to come to the hotel and have a visit with me, give me any information that might be helpful in the short time I had for preparing some suitable ideas, give me something of the history of your organization, its objectives and its accomplishments to date... would I be so good as to meet him in the lobby of the Seelbach in ten minutes? So in ten minutes I went to the clerk at the desk and inquired for President Groseclose. The clerk said, "Yes, he was here only a minute ago, inquiring for you, but he's disappeared. But if you'll just sit down and wait a moment, I'm sure the gentleman will return shortly. Presently Colonel Groseclose did return, and I'm sure he is a gentleman, for the door from which he emerged proclaimed him to be one (wild hilarity). We had a most interesting chat together, and even then I had a bit of hesitancy about coming, but the Colonel said, "Oh, please do come...this other chap (Breeze, was it? - yes, Breeze) has fallen down on us." How can he fall down on him if he isn't even here? Perfectly silly, isn't it! Later, Mr. Sorensen said, "Mr. Briese stood up on us (laughter and correction by member audience). Oh, stood us up on us! So I say, your American vernacular is screwy. One says he fell down on him and the other says he stood up on him, yet it's all supposed to mean the same thing. Later, the Colonel said, "Oh, please do come, I know the ladies and gentlemen will be delighted to hear your accent. I have no accent....I speak English. It's you Americans who have the accent.

But the Americans are interesting... a fortnight ago I was invited to come to Texas....to El Paso....and everyone said, "When you go to Texas, you're on your own." But they didn't say on your own what! Everyone said you're on your own....period, and truly they are a strange breed in Texas, aren't they! I met a chap here today who now sits in the audience and who tells me he is from Houston - a Mr. Scharff.

He gave me a map of the United States, a large drawing....an engineer's sketch, apparently, of the United States, and the territory (or is it a State?) of Texas which is shown to occupy at least as much space as all the other 47 states combined. I knew Texas is big, but I didn't know it was as big as all that. So I said to Mr. Scharff, "How about all these outlying states?" He replied vehemently, "No state outlies Texas!" My word! (Laughter). But you don't do so bad in Kentucky, either, do you? The Colonel and I have been exchanging notes and showing each other our clippings. Here is one that is going into the book "So This Is America!" It has to do with a wedding ceremony here in Kentucky.....the bride and groom exchanged WOWS (laughter). That is a new ceremony, isn't it? (Continues reading.) "After the ceremony they repaired to the home of the bride's parents for a wedding breakfast. The bride's mother sat at the center of the table and poured tea from both ends." I don't believe it can be done!

But truly, America is a land of milk and honey, isn't it?.....(Voice from audience "It sure is, and don't you ever forget it!") Yes, you have everything in America that one could possibly wish for. Sometimes one wonders whether Americans appreciate all the wonderful bounties available at your very fingertips. More food than you can consume. It seemed a pity tonight to see large portions of luscious meat on your plates sent back to the scullery, uneaten. I think you have become so accustomed to having more than you need that it doesn't occur to you that others would be very glad to receive just what is wasted in America. Not only in food, but in industrial goods....in many things....but we won't go into that. Our meat ration in England today is 12 ounces per week. Fortunately, we are going off the meat ration next month, but the supply will even then not be adequate. But we are not complaining; I think our general health is at least as good as your own; at least we do not consume more than we can absorb. And horse meat is available on certain days on the open market, but the supply is never quite enough to fill the demand... and the queues were never longer in England than they are today. In America you have more than you can consume. You do attempt to eat it all...and you do develop these voluptuous waist lines (looks over audience). I believe you refer to them as some sort of windows, don't you....is it "picture windows?" (Audience shouts "bay windows")....Oh, yes, bay windows....not picture windows. And not only here in Kentucky does one encounter them, but everywhere in America. In one of the eastern cities....I believe it was Boston....they told me they have in Boston even what is known as the "Back Bay" district.....I din't get to see that....perhaps on the return trip. (Laughter and applause).

I am sorry I did not have the privilege of attending more of your sessions. I just got a glimpse of it as Mr. Groseclose showed me the rooms in which your meetings were held. I was interested to see on the wall the emblem of your territory, your State, of Kentucky....two men standing together and shaking hands. One had his hand on the other's shoulder, and the slogan of your State, "United we stand - divided we fall." I think that is a beautiful emblem, not only for Kentucky, but for everyone, everywhere. In my opinion, the days of the rugged individualist are over...the rugged individualist that one read and heard so much about a decade or two ago. Today, when governmental bureaucracy has risen like a tide, reaching into the pocket of each individual engineer, and every American, for a greater share of his earnings for the perpetuation of even further bureaucracy. If men are to continue to thrive and prosper against such a tide they must realize that any individual facing it alone would be destroyed. But today men are learning that the dawning day is one of cooperation and collaboration with his fellows....that by working harmoniously together, combining the strength of your shoulders all pushing in a given direction, then you will speak with a voice of such authority that no legitimate purpose may be denied to you. When one helps his brother to cross the stream he finds that he is also getting across himself. Now, I am not saying that

you should go immediately after this program to the Ohio river and row another engineer to the other side in a boat. I doubt it would be safe after what I have observed here in the hotel last night, what with the stormy weather and the waves rolling so high. I noticed, for example, a meeting going on in one of the host rooms. One of the manufacturers was entertaining various customers and friends. I noticed they were entering the room optimistically and coming out again misti-optically. The waves were rolling so high some of the men were scarcely able to stand up in the boat. I'm sure it would not have been safe to attempt a crossing over the river, although some of the brothers could have used a little assistance. Some of them were playing a game they called hop-scotch. When I asked about the rules of the game, one of them explained that they use real Scotch. (Laughter). I thought one of them was a test pilot for Old Crow. Doctors will tell you it is not good to drink to excess....that one lives longer if he drinks less. Yet, I have noticed there are more old drunks in your country than old doctors. I shall be writing about this in the new book, Mr. Toastmaster. (Laughter).

I have been quite interested in your program. I see something about Operations Research. Of course, operations research is something we are quite familiar with in England. I think we probably initiated that type of operations in England many years ago, as we have initiated many things in England, the Mother Country, that have eventually been adopted by the Americans....and it is good that you do so. I think it is groups like your own, who have more than the ordinary degree of education that are able to grasp those things, those ideas, that we can't see with the naked eye - those things that are of the intellect, grasp what is good from them and carry on. We are doing a great deal of operational research; we are not so much interested at the moment in this ....what is it you call it when you do everything automatically?.....I mean, without all the manpower? We are not so interested in that as you, because we have men in England who appreciate having a job and earning their day's pay. In America, again, you have so much of everything that those who are in production are not so much interested in carrying on. They get more wage in one day in America than they get in England in a week; more than in Russia in two weeks. So Americans have come to a point - I think perhaps not many of you in this audience - engineers - but many of those with whom you are associated - to the point where they feel they need work a day less each week for the same pay, and then when that is accomplished, an hour or two less each day. They like to do an honest day's work for an honest week's pay. That also is going into the book, and I am going to elaborate on it, that angle of it, seriously, in the book. Well now, I don't quite know where to begin or where to end; as an example, we in England are doing a great deal of research. I think we are about two years ahead of the Americans in air travel development. Our Armstrong Vickers plane within two years will be coming to America carrying 200 persons, and traveling with the sun. A plane in two years from today, I think it is not inappropriate to predict, may leave London, let us say at 8 in the morning, and land in New York at 8 in the morning, and land in Louisville at 8 in the morning, then on to San Francisco and still land at 8 in the morning. In other words, gentlemen, while I can't go into details and definite plans now on the drawing boards at the moment, but let us say two years and then see how close we come to it. Now that is going to bring us a problem, and perhaps a happy one, of where we are to feed these passengers. With the shortage of food in England, if it continues, we may send them to have their breakfast in New York.....or San Francisco. (Laughter).

I met an interesting chap here just before the dinner, Mr. Tom Potter. We were discussing England, the Mother Country, and he said "Yes, England is the mother country, isn't she? Always expecting!" (Laughter). You Americans are so facetious. One never knows whether an American is telling the truth, whether he is being facetious, or whether he is pulling one's leg a bit. Then I met also an

Irish chap, McCormick - Bob McCormick. He asked me how long I had been in America. When I told him I just came across a few weeks ago, he said, "How very strange. I didn't know an Englishman ever came across!" (Laughter). Perfectly silly, isn't it! How could an Englishman be in America without coming across, that's what I want to know. (Laughter). It can't be done. The only way I can imagine is that he must have been born here, and then he would be an American, poor chap. But I did come across, and there again, I don't know why an Englishman should ever stop to talk to anyone by the name of McCormick to begin with. As you know, in England we've had a bit of difficulty with the Irish for quite a number of generations; in fact, ever since the Irish got up on their hind legs and began walking in an upright position, like human beings, we have had trouble with them, all the way down from De Valera to the McCormicks - and that's as far down as you can go, except perhaps the O'Riley's. (Laughter).

Well, here we are, at a convention of American Engineers. In England we are always given to understand that when the Americans have a convention, they meet, eat, belch and adjourn. (Laughter). But I'm sure, ladies and gentlemen, that is not the whole story. I see from your program that this organization is only in its fifth year of existence. Why, you are only in your swaddling clothes. You are just beginning your young lives as an organization, as a society, and many of you as engineers. But any organization that in five years can present within the confines of one room such a splendid aggregation of ladies and gentlemen as is represented in this room at this time, and of such high caliber, must have something very vital in its sinews, something very worthwhile in its veins. Mr. Sorensen tells me he has been in the engineering industry for some 17 years, and 17 years is a comparatively long time. Many changes have been wrought in your country since Mr. Sorensen took up engineering, and probably many more changes will come about in the next 17 years, and indeed, in the next five years of your existence as a society, or asso ciation or whatever it is that you call it. Seventeen years ago the order of the day was different. Every manufacturer, every tradesman and every salesman looked upon his competitor across the street as a public enemy, a hated rival. He considered his associate in the same line of business, or profession, as having horns on his head, and a spiked tail, someone to be destroyed if possible. The order of the day was that of fang and claw....the law of the jungle. But today, Mr. Chairman, we are fast learning that the day of the rugged individualist is no more. Some are still riding in the past, but the people who are keeping abreast of the times, those who associate themselves with other leaders in their business or profession as you are doing in this Association, are learning that changing methods make it necessary for every guild to work in close harmony. Against a rising tide of governmental bureaucracy, and tax-raising bodies, formed in many instances for the prime purpose of reaching a bit deeper into the pocket of each individual engineer for a greater part of his earnings for the further perpetuation of bureaucracy, I say men are realizing that the day of the individualist is over. If you are going to progress as far in the next 17 years as you have done in the past 17 years, you are going to learn that each individual will progress farther and faster when he becomes part and parcel of his trade association, his society, where all gather together and exchange ideas. Each member, of course, has his limited ideas.....the next man has also his limited ideas, but many of those will differ from those of the other. By combining all these ideas, tossing them into this big melting pot, in this case the A.I.I.E., so that every member can reach into the pot and take out several ideas, any one of which may spell the difference between success and failure in his career. Men are learning that no single person can stand up to this rising tide of bureaucracy. But though all engineers, for example, would be destroyed by this tide as individuals, by combining your ideas, by joining shoulders and all pushing in unison in a given direction, then you will speak with a voice of such authority and of such incisiveness and clarity that it will be clearly heard over

the ramparts of bureaucracy and even into Washington, so that no legitimate purpose may be denied to you.

There is one idea I should like to leave with you tonight, if I may....and that is that tomorrow when you meet in this room continuing the serious aspects of your convention, that you carry in your pocket a notebook and jot down on a tiny bit of paper, if you please, every idea that is brought to you by the various speakers tomorrow....because those ideas, gentlemen, are the most potent tools for success in your profession that could possibly be presented to you. Sometimes men struggle to the very limit of their physical endurance for something they can see with the naked eye, something that money can purchase, something tangible, quite forgetting that the most effective tools of all are intangible ideas....ideas that can't be seen with the naked eye. Oh, you fold your arms and say that's a good idea and that you must remember it. But don't depend on remembering.....jot down every idea in a word or two at least. I don't care how indifferent or how lacking in talent your speakers may be, they are bound, each one, to bring you at least one idea, some, perhaps a dozen. So jot down the essence of each idea....just a word, or a sentence, that is brought to you tomorrow. Then you will go home from this meeting to your offices again filled with a banquet of new ideas in addition to those you already had....new tools in your tool chest that may be transmuted into better engineering.

Thus you will produce the job with perhaps less effort, and certainly do a better job. Let me illustrate it in this manner - here is, let us say, a gallon of petrol (holds up pitcher of water); it's water, but let us say for illustration it is a gallon of petrol(aside, to member leaving room, "Well, when you've got to go you've got to go, don't you!")...(Laughter). Very well, here is the gallon of petrol. I believe you here in America would call it "gasoline," wouldn't you? It's PETROL, gentlemen. (Laughter). However, let's not quarrel about it. It's still a gallon of petrol. It has been produced by dint of great engineering skill and the investment of a great deal of money. It has been refined to a point where it may now be purchased by you, or you, or you....any one of you, to do a job for you. Very well, if you purchase the gallon of petrol and pour it into a jug and set it away and don't use it, it will evaporate. It's potency will have been wasted. Had you placed it in a metal container and applied sufficient heat underneath it, it would explode. It is dynamic.....it has power. Perhaps in that explosion no good has been accomplished; perhaps in that explosion no progress whatever has been made; perhaps, indeed, a great deal of damage may have been created. A hand may have been blown away by dint of misdirected energy. However, place that gallon petrol in the tank of your motor car, hook it up to your engine and it will pull a load for you. It might have driven your motor car to Atlanta (I don't know how far that would be) but it would have been of use to you. What I am attempting to show is that ideas brought to you here at this convention, and other conventions and meetings of your society, are veritable tool chests; don't waste them. Jot them down on a piece of paper, take them home, refresh your memory, they are the greatest tools that can be brought and presented to you.....You who have been fortunate to be invited to this meeting and to membership in this Association. If you're going to get the most out of your membership and your attendance, you must put something of yourself into it, and I'm not talking of the paltry few dollars of membership dues. Sometimes men complain a bit about the Association dues.

I think you have a word for it here in America, "Bellyache." (Laughter). Yes, members bellyache about their Associations, what it is doing, about what it should do, or what it is failing to do... and yet, when a chairman of a committee comes and says, "John, or George, or Bill....(or whatever it is), we have a job to do in the A.I.I.E. and we need a committee of five. We are inviting you to take part in it." He throws up his hands and says, "Oh, I'm too busy, and besides, my feeble

efforts would be so insignificant they wouldn't be noticed....and not only that, we have a President, and we have a Secretary, and we have a Board of Directors... they are the ones to carry on the work of the Association, it isn't for me to worry about." Well, this chap is missing the bus. He is missing the grandest opportunity to open his mind and let the ideas flow that would come to him automatically by doing this service - this contribution to the Association. I was recently the guest of the Mayor of Chattanooga, in Tennessee, who told me an amazing tale that will illustrate my point. He said that about a year ago the citizens of Chattanooga got together and presented him a saddle horse. A beautiful beast, and he was delighted with it, but he had no place to take care of the horse. So he went to a riding academy at the outskirts of the city and asked the gentleman what he would charge him to take care of the horse. This gentleman quoted him a price of $25.00 a month. The mayor estimated quickly and said "$25.00 a month.....that would be $300.00 a year. There will also be a saddle to purchase, bridles to buy, grooming to do, and other sundry expenses. I wonder whether I can afford to maintain the horse. As Mayor of Chattanooga I must set a good example in a civic way and contribute liberally to all these civic needs. Here is the Polio Fund, the Cancer Drive, the March of Dimes, the -- some sort of Chest -- is it the "Communist" Chest (shouts from audience) Oh, yes, Community Chest (laughter), and various other causes. I must not spend too much on my foolish desires. I'll think about it." He then remembered that his wife is the President of the Garden Club, and every spring she is after the mayor for a bit of money for bulbs for the flower garden, for seeds for the flower garden, for trimming the hedges, for mowing the lawn, and .....oh, yes, for fertilizer for the flower garden. Then he thought, Oh, the fertilizer from the horse....that would be one item of saving. He asked the gentleman if he might have the fertilizer from the horse for the flower garden, but the man replied, "Well, Mr. Mayor, it hasn't been customary." So the mayor went next day to another riding academy and asked that chap what he would charge to take care of the horse. This one quoted him not $25.00 per month, but merely $5.00 per month. The mayor said, "Splendid, I shall bring him out tomorrow, and how about the fertilizer for the flower garden?" And this chap said, "Well, you know, Mr. Mayor, at only $5.00 a month, there won't BE any fertilizer. (Laughter and applause.)

Now, what I'm attempting to say (continued laughter)....it IS a bit earthy, isn't it! -- but is there not a beautiful philosophy of business in that little tale! I think if every engineer in this room from this moment on remembered that philosophy and carried on with the idea in mind that you don't get too much out of your organization, or out of your job, so far as that is concerned, unless you put something of yourself into it, something in the way of intangible ideas rather than just physical properties. That is just another idea I should like to leave with you. Oh, you have such wonderful opportunities in America, seven thousand two hundred additional Americans every day. I've learned some vital statistics since I've been in your country. You may go home from this convention, sit down to your breakfast table and see in your mind's eye 7200 new Americans who were not there this morning and who will require engineering services. You say, "But they're infants - they're merely children - they may need milk but not engineering services, yet for every 7200 of these new Americans every day, 7200 others are going forward in some way, marrying, building homes, going into business, requiring the services of engineers. Isn't it a wonderful thing, Mr. President, that you have such opportunities in America. It seems a pity that men sometimes miss that idea, and fail to put the best that they have of themselves into their organization and into their work.

I want to compliment you in the splendid leadership you have on display at this meeting. I was introduced today to your Mr. Donald Malcolm. There, in my opinion, is a real leader of men and you are to be congratulated for bringing men of his caliber into your organization. It seems to me since I have been in the States, that only about one in a hundred American men are real leaders of men....one in a

hundred....the other 99 are followers of women. (Laughter). I'm sure Mr. Malcolm is not one of those, though I've not interviewed Mrs. Malcolm about it. I don't know what she would have to say on that point. Indeed, sometimes one wonders if it is not the women of America who are the real leaders of men. And when it comes to that, I can't think of anything that would be more delightful than to be led about by an American woman, or a group of them, so far as that is concerned. But the women of America are so enterprising. Your women do everything the gentlemen do, and do it so capably. They go into business; they go into the professions - medicine, law, politics. I was amazed at the number of American women in your Congress in Washington. Yes, even in International Relations. Nothing stops the American woman. You had until quite recently an American woman as Minister to Luxembourg, Pearl Mesta, and a splendid job she did of it. You have at this very moment an American woman as Ambassador to Holland, Mrs. Anderson of Minnesota. You have today also an American woman as Ambassador to Italy, Clare Booth Luce. And your American women did so much even in the war effort as well.

I recently passed through a city, Mobile, Mississippi - thank you, yes, Mobile, Alabama - and there in Mobile Bay were a number of warships - hundreds of them, it seemed. When I asked my host what they were doing there he told me they were fighting ships now in moth-balls. That's screwy, isn't it, but what a splendid business the moth-ball manufacturers must be enjoying. In England we use moth-balls during the summer season in our woolens and in our furs; in America you put them on warships, such as the Texas, the Kentucky, the Missouri and others. In fact, I understand it was an American woman, Gypsy Rose Lee, who finally stripped the "Mighty Mo" for action. (Laughter). So you see, Mr. Toastmaster, a few of the things that I am going to have in my book "SO THIS IS AMERICA!" Your toastmaster said he hoped I would mention something of the contents of the book so that he would know whether to expend - what did he say, three bucks? for a copy. May I say that if I should stay another six weeks in your country, as I'm certainly hoping to do, I'm afraid the book shall have to come out in two volumes instead of one, and that will cost your toastmaster SIX BUCKS (laughter and applause.)

Well, that is only a smattering of it; I said a moment ago that I had been in Texas; El Paso, Texas. Oh, but that was an interesting experience ....the Scottish Rite, 850 ladies and gentlemen in the Scottish Rite Cathedral. I was scheduled to speak on Monday but I arrived in the city on Saturday. I rang up my chairman, Mr. Alfred Ponsford, of the big engineering firm of Ponsford Brothers. He came to the hotel and we had a delightful visit together.

He said, "Now, tomorrow is Sunday; I should like to have you come and have dinner with my wife and me, two of my brothers and their wives, and two friends and their wives. There will be nine of us altogether. After the dinner, how would you like to come as my guest to Juarez, Mexico to a bullfight?" I had never witnessed a bullfight, and felt it would be a rather bloody mess....but he pressed me a bit, and said "You know, the bullfight is like any other sport; if you understand it you'll get a big kick out of it. It has its subdivisions, called tercios. In football we have two halves; in baseball six innings, or seven or whatever it is (shoults from audience - nine!) Very well, nine! I suppose the next American I ask about it will say 10 or 12. At any rate, Mr. Ponsford said he had a very interesting booklet on bullfighting and that he would bring it to me. He went away and later returned with the book and gave it to me....See, here it is....tells all about the breeding of the bulls, the philosophy of the bullfight, the matadors and their training, the colorful raiment they wear in the bullring, the technical points of the footwork, the use of the muleta and all about it. It even explains the work of the picadors on their horses; even why the bull rushes at the matador. Everything is explained in this book (displays booklet)....I saw it all in person. When the

matador finally flings away his muleta and enters the bullring with nothing to protect him, nothing behind which to hide, there stands the bull bellowing and pawing the earth, trying to determine whether to annihilate the matador at once. And there stands the matador a few paces away, observing the bull's frustration and rage. He shouts at the bull "Hola! Hola!" or something that sounds like it. He is actually inciting the bull to attack. Finally, the bull decides he will have no more of it, and makes his attack. The matador runs away....but he does not run in a straight line, for that would be fatal. The bull can run faster and would catch up with him. So the matador runs at an angle of 90 degrees, at right angles, in other words. The bull, noticing this, turns and proceeds to close in on him. Now, the object of the game, as I understand it, is to miss the bull's horns by at least half an inch. I was talking to Colonel "Grows-Close"....(Thank you, Colonel, for the correction)....well, at any rate, he does grow closer to one, doesn't he... splendid chap....but Colonel Groseclose said when I was telling him about the bull fight, "Oh, yes, I know all about bullfighting. In my younger days I spent some time in Mexico and took up the sport of bullfighting as a sort of avocation, or exercise. The Colonel tells me he found he was so proficient with the bull (laughter and shouts from audience)....that the natives invited him to put on a professional exhibition of his skill in the bullring (which he did.) In fact, he accredited himself with such skill and technical precision and such bravery that they invited him to repeat his performance the following Sunday. He accepted the invitation, much to his chagrin....it was decidedly a mistake. Colonel Groseclose told me during the dinner of how his heart would swell with pride when he came marching bravely into the ring, wearing his gaily colored habilaments, flanked by his picadors and his peons, the brass bands playing march music, and the crowds shouting their acclaim to Colonel Groseclose, the new American bullfighter! When he reached the center of the ring he doffed his headgear, threw it high into the stands, bowed low and then threw out the challenge, "Now bring on the bull!" As I said, on the first Sunday he did a perfect and artistic job. But by the second Sunday he had become so enamored by the plaudits of the crowds, and over-confident over his skill that he forgot one most cardinal rule of the bullfight - that one must NEVER take one eye off the bull. While he was bowing low to the crowds, accepting their plaudits, the bull made a sudden rush at him. Before the Colonel realized what was going on, the bull was almost upon him. He did run away, but being a bit confused, made the mistake of running in a straight line. Here came the bull, closer and closer, head low and horns plunging precariously at a vital spot. It looked bad for the Colonel, but the bull for some reason....now, this one I don't find in the book....did you say, Colonel Groseclose, that the bull had a flock of geese sitting on his horns? I don't find that in the rules....(voice from audience "ONE goose")....yes, that's it....one goose...and with that one goose the bull completely ruined the Colonel's bullfighting career (tumultuous applause). So the Colonel, I understand, has gone to wrestling with the bull instead. In fact, some of his friends have told me that Colonel Groseclose can throw the bull faster and farther than any other engineer in this Association. (Laughter and applause). (Shouts of "that's right!").

By the way, am I talking too long, Mr. Chairman? "About time"....About time to what? Oh, time to continue....well, thank you. Is it the wish of the audience that I continue or stop at this point? (Applause and shouts). Was the applause for stopping? Well, at any rate, I have been asked by your chairman if I would say a word about my mission in the States in behalf of the Foreign Office. I had not intended going into that, but I suppose it would be not inappropriate to do so, at least to mention a few words about it. Although my part in this mission is of a rather minor proportion and will be concluded upon my return to Washington, the whole pattern is part of a great movement, and that is for the purpose of cementing ever closer and closer Anglo-American understanding and friendship. I think that is a

very necessary thing. So does your Treasurer, Mr. Farnbacher. He was telling me what an important job he has, what a busy task it is to handle all the funds of the members of this Association, all the funds and monies constantly rolling in off the members' fingers and into his care. Mr. Farnbacher made a point I had not thought of, but it is most interesting and important and necessary to know from an economic viewpoint. Mr. Thorncracker...Thornpecker...(thank you). Mr. Thornbaccher says that when the members pay their dues into his office there is a period in which the money lies there as "dead dollars", and while eventually it finds its way into the regular channels of industry again, there is a period in which those dollars lie in his office doing absolutely nothing. It is quite surprising what a large sum it amounts to, so Mr. Farnbacher (and I want to congratulate you on having selected such an astute and clever treasurer) says that he has found a way to put those dollars to work for him personally while they are resting. The very moment you pay your dues or other monies into his hands, he is able to milk them for his personal account, even overnight, before they are required for official deposit. (Laughter). Well, as he says, they are just lying there dead, anyway. He has had some very good tips on the market; in one case I believe he told me he had some unusual luck in a horserace; and he has a very nimble and educated touch in a game I believe you call crap. (Laughter). Oh, no! He puts it all back, always in the nick of time; at any rate, they have not caught him as yet. What I mean to say is he tells me he has been very successful in building quite a sizeable fortune for himself. Sometimes, he says, he scarcely knows what to do with it all or how to invest it to advantage. So I said, "Mr. Flimflammer, in those circumstances, how would you feel toward a rather substantial loan to England in this coming emergency?" He said, "Well, how's your credit?" My Word! Why, that's the first time we've ever had a reply like that from any American. Then he said, "What collateral could you offer...it seems to me you defaulted in your last loan." Why, ladies and gentlemen, that is from the pages of past history and why should it be brought up again? But I know you Americans don't like to make straight loans. You like to make deals. I read in the press only yesterday that one of your baseball teams disposed of a valuable player...made an exchange with another team....sending them one player and getting in return three players and a sum of money. Yes, for one batsman...,or was it one pitcher, yes, for one pitcher the other team sent them a catcher, a secondhand baseman, something else and a sum of $25,000. Now, that's a deal, isn't it! That's the way you Americans like to do business....four items for one. So I thought to myself that if I'm going to be successful in doing business with Mr. Firmbreaker I must conjure up a deal. I said, "Mr. Farnbacker, I think I have it! We had in England a few years ago an election, in which we disposed of the services of some of the brightest brains in Britain. We threw out the socialist regime, lock, stock and barrel. We set an example for you Americans to follow, as we of the Mother Country have done before in orderto help you. In this case you were slow to catch on, but you finally did it. While we in England took the bull by the tail and faced the situation, you in America dilly-dallied about even referring to them as "Socialists", for fear of offending their mentors, the Communists, those termites now crawling about in the very - shall we say - foundation structure of your government and crumbling its strength. Even today you are so hesitant of offending someone if you accede to the demands to have them cleaned out of your government. I could say many things about that but this is not the time nor the place to do so....so I continued and said, "Mr. Farnbacher, when we threw out the Socialists we retired the services of such men as Harold Wilson, our Secretary of Labor, a smart man; Aneurin Bevan who has been a thorn in Winnie's side and to whom Winnie refers without pronouncing the first syllable of his Christian name. Yes, even Clement Atlee himself. So I said to Mr. Farnbacher, "Let me propose a deal; suppose we send you Harold Wilson, and Aneurin Bevan, and throw in Clement Atlee for, let us say, Dean Atchison and $6 Billion." Mr. Farnbacher almost shouted "It's a deal! And we'll throw in Harry Truman!" Well, ladies and gentlemen, really, I don't know what we

could do with Harry Truman.....unless of course, he would bring along a few mink coats and perhaps some deep freezers. Really, I'm afraid we'd be very much better off if we should give you Clement Atlee and the others and have you keep Harry Truman at home. (Laughter).

Oh, it's good to see the Americans laugh. And I think, Mr. President, it is not only good that you should do so, but it is important to have in this convention, a session such as this....a meeting where men and women can gather together, break bread with their fellows and friends, learn each others' problems and at the same time enjoy the lighter moments....a bit of laughter. That is the leveling off process that clears the cobwebs from a tired, over-wrought brain and helps do a better job of keen thinking again. Of course, we all have serious problems that must be met anew each day, that must be overcome in some manner. But if one is so constantly in serious mood as to never have a bit of fun after a bit, it dulls the wit...it dulls the intellect and one gets into a sort of rut that he wears deeper and deeper as he goes along back and forth in it. He finally wears the rut so deep that he can't get out of it, again. He becomes a fit subject for a mental institution....and I understand your mental institutions in America are already overcrowded. You have more patients in mental hospitals today than in all other hospitals combined. So I think it is extremely important that you do provide some fun at your conventions, lay down the serious aspects of your work and enjoy an occasional session of laughter. That, gentlemen, is the overflow valve, the leveling off process that clears the cobwebs of confusion from a tired, overwrought brain and makes it possible for your members to return to the serious aspects of this convention tomorrow with sharper, clearer minds, and produce better results with those intangible tools, ideas. The human mind, or the human brain if you prefer, is very much like a sponge. If you should spill a glass of water on the table (does so) and grasp a sponge to sop it up again, and there is more water than the sponge can absorb, then the sponge becomes absolutely useless. Every pore is so thoroughly saturated it won't hold another drop. But if you quickly squeeze the water out of the sponge, it will do the job all over again. The human mind is exactly like that. If you think of nothing but engineering, and never have a thought for a bit of nonsense, after a bit you can't think clearly....the brain has become so saturated you can't carry on and do the job as well as it should be done. So I say, it is important that you have such a session as this, some lighter moments, so that your meeting tomorrow may be an absorbing one. (Applause).

When I was a guest of the Mayor of Chattanooga I was invited into the mountains to view the coal mining country and to go into one of the mines, which I did. My host drove me in his motor car through some of the most magnificent mountainous terrain I had ever seen. Rugged mountain tops reaching for the skies; trees growing from the sheer cliffs, their tops literally above the clouds; winding roadways back and forth across the mountains. One could see them across the valleys on the adjoining mountains, like a great ribbon unwinding across the landscape. Sharp, wicked turnings, and at times one automatically shrank back in the seat of the motor car, hesitating to look through the windscreen and over the bonnet for fear the motor itself would suddenly leap into the chasm far below. But always there was a quick turning of the wheel and there we would be again. Suddenly we came upon a small village; perhaps a dozen miserable cottages, miners' huts, in the center of which stood a small shop with a great many things for sale, such as brooms, and shovels, and rakes and food stuffs; a petrol station - Oh, a great many things. On the porch sat an old gaffer, with an old, battered felt hat and a long, straggly beard. The beard looked even more dilapidated than the old gentleman himself. He was busily making shavings from a bit of wood. A long bit of wood in one hand and a blade in the other, making these shavings that curled upon themselves, like a cock's comb. Most interesting! Suddenly the motor car had sped by; I asked my host what that old chap was manufacturing. He said, "Oh, he wasn't making anything in particular;

in this part of America the natives have very little else to do, so they sit about, spending a great deal of their time -- ah-h-h-h....chiseling? No, that doesn't seem quite right! (Voices from audience "Whittling"). Oh, yes, whittling - not chiseling (laughter.) Oh, I see (confusedly), that chiseling is something else again. (Laughter). It seems to be quite a familiar term among the engineers. (Prolonged laughter and applause). Well, at any rate, let's take this old gentleman as an illustration. Let us assume he is so busy whittling that he never takes any rest; what happens? Why, after a bit his blade becomes dull, and as he proceeds it becomes more and more dull, doesn't it, and as it does so it calls for more and more strength on this old chap's part to produce those shavings. Not only that, but in spite of his best efforts those shavings become less and less perfect as he proceeds and the blade becomes more and more dull. Now then, if he were to take a bit of time out occasionally and have his blade sharpened, then he can return to his task, produce better shavings and do it with greater ease. I should like to think of the engineers sitting in this room at this moment, as enjoying an interlude of sharpening the blade; of sharpening the intellect, if you please, forgetting for a moment the serious aspects of your job, the serious objectives of your convention, and just having a bit of fun, a bit of laughter, because that is the squeezing the water out of the sponge, so that tomorrow you may return to the business sessions of this meeting with a sharpened intellect, and grasp the ideas, these intangible tools that are being brought to you in such profusion. I think it is extremely important. After all is said and done, what are the most important things? The most important things are not the tangible instruments that are brought to the individual engineer: they are the intangible skill with which those tools are used. The most important things in a home are not the furnishings that home contains, that money can buy, that fire may destroy before the sun rises again. Important as all those things are, there is something more important in the home than that, and it is the intangible relationships that exist among the members in that home that count most; and in my humble opinion, Mr. President, the most important thing in this convention is not the names of the members in attendance, but rather it is the intangible relationships developed among your members and friends here, all working toward a given purpose - working together - those are the really important things. You are builders here; you are building something probably better than you realize. Not something you can see with the naked eye, but you are building a structure taller than this Kentucky Hotel, if you please, and you are still in the foundation stage of it. But you are making progress - and I should like to close with a bit of poetry, if I can recall it - that will illustrate my feelings about your meeting:

I watched them tearing a building town;
A gang of men in a busy town;
With a "ho-Heave-Ho," and a lusty yell
They swung a beam, and a sidewall fell.

I said to the foreman, "Are these men skilled
As the men you'd hire if you had to build?"
He gave a laugh, and said, "No, indeed;
Just common labor is all I need;
These men can wreck in a day or two
What Builders have taken a year to do."

I asked myself, as I went my way,
"Which of these roles have I tried to play,
Am I a builder, who works with care,
Measuring life by the rule and the square?
Am I shaping my deeds by a well made plan,
Patiently doing the best I can?
Or am I a wrecker, who walks the town,
Content with the labor of tearing down?"

Ladies and Gentlemen - Goodnight!

MR. SORENSON: Thank you, Major Bates -- that was an excellent --- Oh! I just saw Mr. Briese (*) enter the room. Mr. Briese, won't you please come to the speaker's table --- (everybody turned to look in the direction of the door -- during this brief distraction -- Major Bates, who just finished speaking, removed his English disguise, and English accent. The audience's attention was quickly directed to the speaker's rostrum -- when Mr. Briese spoke in American accent -- "Gentlemen, I am not Major Bates. I have never been to England. I was born and reared in Toledo, Ohio." The room went into a hilarious and prolonged laughter. He was given a rising applause of several minutes.

(*) Major Bates and Mr. Briese one and the same person.

ENGINEERS' BANQUET: Wednesday, May 5, 1954.
Presiding Officer: Mr. W. N. Bryant, Past President, Louisville Chapter, AIIE.
Also: Production Supervisor, American Saw & Tool Company.

Speaker: Mr. J. A. Getzow, President, Kentucky State Chamber of Commerce
Also: President, Sportleigh Hall, Inc., Harrodsburg, Kentucky.

Address: "KENTUCKY INDUSTRIAL PROGRESS".

MR. GETZOW: The real Industrial growth of Kentucky started about 1945. We call the period from 1946 to date the Renaissance period of Industry in Kentucky. Since 1946 -- the year in which the Kentucky Chamber of Commerce was organized -- an impressive array of industry has come to the Commonwealth. A total of 528 new and expanded industries were announced during that period, creating 88,646 new jobs with a plant investment of close to $2,000,000,000.

During 1953, 35 new plants were started in Kentucky, creating 3,275 new jobs. These jobs yielded a payroll of $9,825,000 and the new plants represented an investment of $11,801,000. While these new plants were moving in, an expansion program was going on, an expansion of existing facilities. This resulted in the creation of 6,709 new jobs with a payroll of $20,127,000 and $75,430,000 was spent in plant investments for all expansions.

Let's take a look at what we have to offer in Kentucky. We are ideally located in the U.S. as a central distribution point. Kentucky consists mainly of small towns. Louisville is the largest town, and if we were to include the entire metropolitan area of Louisville, the population would approximate a little over half a million people. Another large town in Kentucky is Lexington, with a population in the metropolitan area of approximately 100,000. The largest of the other towns are Ashland, Paducah, and Owensboro, with populations of less than half that of Lexington. The rest of the towns vary in population from 1,500 to 20,000.

How does this present a favorable picture for the location of industry? Well, for one thing, there is plenty of room for building and future expansion. Communities are closer to the problems of new plants and can help. Since our population is spread fairly evenly throughout the state, each town has an excellent supply of young trainable labor. There are 3 major railraods inter-winding throughout the state. Almost every town is either on the main line or has a short spur line feeding into it. We are abundantly stocked with natural resouces, and have attracted those industries requiring these resources as a basis for their operation. The best example of this type of industry is represented by the growth of Calvert City. 5 of the largest national chemical manufacturing companies have located there recently.

Because of the many natural and man-made waterways in the state, there is practically no spot in the Commonwealth where there is not an adequate water supply for consumption or navigation. During the past 5 years, new pipe lines, providing natural gas, have been brought into almost every community in the state, providing a less expensive type of fuel. While it is true that most businesses, seeking new locations, look first for the things I have just outlined, there are other things equally important in a continued successful operation after a plant has been permanent located.

The Industrial Development Committee of the Kentucky State Chamber of Commerce directs the greatest part of its efforts toward community development, for we know that a community providing all the facilities for attractive living must also be attractive to outside industry. One of the Committee's objectives was to prove to the local communities that their wealth could be increased without necessarily bringing in new factories. The first test city was London, Kentucky. I was told, recently, by one

of the leading citizens in that town, that their community had become such a wonderful place in which to live that 450 new families had made this town their home. They were families in the income bracket of from $5,000 to $10,000, and primarily consisted of salesmen and factory representatives who operated in that area of the state. It is estimated that the purchasing power of these new residents of London is equal to the average payroll provided by a factory employing 300 to 400 people.

About two years ago the Kentucky Chamber of Commerce started its first industrial tour. We invited leaders from those communities seeking industry to join us in a two day work session. For two days, we traveled, visiting towns that had a new plant located in their area in the past 10 years, and which had a successful history of operation. We questioned the owners of the new plants about their requirements in seeking the new location, and how they happened to locate in that particular town. We questioned the local officials about what they did to get the new factory, and what they were doing to keep that factory there. A great deal of information was gained by all on the subjects of labor, the importance of the co-operative attitude on the part of the local citizens toward new business, and the continuing of that interest in the future problems of the new business. As a result of the tour, activity was stimulated to the extent that a number of new businesses located in their towns. The publicity and attendant favorable results of this tour created a demand from other parts of the State for the same service, and so, the State Chamber of Commerce conducted a similar tour in another section of the State.

We learned how a small town located near Camp Breckenridge was confronted by unemployment as a result of the Army's de-activation of the Camp. We learned how these people organized an Industrial Development Committee and with the co-operation of the Kentucky Chamber of Commerce, ingeniously ran down a blind ad, with the end result that they now have a factory, a reputable national concern, located in their town, providing jobs for their unemployed. We also learned how another community campaigned against the organization work of District 50 of the United Mine Workers to the end that 98% of the employees of a new plant voted "No Union"; this, in spite of the fact that 30% of these employees had indicated to the National Labor Relations Board that they wanted District 50 to represent them.

The Kentucky Chamber of Commerce has adopted a written policy, outlining a principle of labor and management relationships which must enure to the benefit of all interested parties. We have never identified ourselves as an enemy of Labor, but rather have sought to obtain those objectives for both labor and management which would obviate the necessity for the tremendous loss of man hours due to Labor-Management disputes. We feel that industry must do a better job of bringing to the attention of local citizenry, factual information concerning Labor disputes. Particularly, in small towns where the local citizenry usually obtains a distorted picture of the reason for the labor disputes from their relatives and friends who are employees. We feel that well informed communities can do the best job of bringing about amicable settlements of disagreements between Labor and Management. We are directing all our efforts, presently, to this end. We also feel that the recommendations of the General Electric Company have great value. "Employees must be more intelligently informed on what is taking place in their own business, that they should know more about the problems and plans of Management." This kind of knowledge must bring about a closer and more harmonious relationship between employers and employees.

I think the best example of what effective community interest can do took place in Central City. As you all probably know, District 50 of the United Mine Workers tried to organize every business in the town. We received the kind of national publicity on this that none of us relish. However, a courageous people, antagonistic toward this undemocratic form of organized labor fought for 8 months with the result that District 50 failed. Unfortunately, we received no national publicity on this.

We in the Chamber of Commerce have been carrying this story to every corner of the State. Senator Irving M. Ives of New York, in expressing his opinion of the Taft-Hartley Act, said, "The most satisfactory and happiest human relationships are the product, not of legal compulsion, but rather of a voluntary determination among human beings to co-operate with one another. Though we may legislate to the end of time, there will never be industrial peace and harmony without good faith, integrity, a high degree of responsibility, and a real desire to co-operate on the part of all parties concerned. Without this spirit of good will, all of the social, economic, and labor laws of man will prove eventually to be in vain." We heartily endorse this viewpoint.

What does the future hold for Kentucky? Will we continue to attract industry? We think the future is bright. With the continued improvement of our local communities, with higher educational standards, with better road systems, with a more equitable tax basis for business, and with a better understanding between Labor and Management; with all this: We know that we have the answer to the de-centralization of large industry in Kentucky and the start of new businesses here. We are making no plans in Kentucky for a possible recession or depression. All of our efforts are directed in a positive way through the expansion of our present industry to bring about what we consider to be an economically favorable balance between agriculture and industry. We feel strongly that we will continue to grow industrially, for we know that the atmosphere we are developing throughout the Commonwealth must attract investors in the sound industrial growth of America.

HOSPITALITY LUNCHEON: Friday, May 7, 1954.
Presiding: Stephen Arthur Derry, National Conference and Convention Chairman (1954). Past President, and Board of Directors (1953-56), Louisville Chapter, A.I.I.E. -- New and Unusual Applications of Industrial Engineering Techniques to New and Unusual Fields. Also President, The Derry Management Engineers, Louisville, Kentucky.

Speaker: The Honorable Alben W. Barkley, former Vice President of the United States.

MR. DERRY: Today's scheduled speaker -- The Honorable John M. Robsion, Jr., Member, House of Representatives, was forced to remain in Washington because of very important legislation coming up for vote today in Congress. In his place, we are very fortunate to have another outstanding citizen from Kentucky to welcome you on behalf of the Commonwealth of Kentucky, --- the Honorable Alben W. Barkley. He happened to be rigistered here in the hotel. Just last evening in this very room, he spoke before an audience of more than 800. About two hours ago, we received word that he would have lunch with us and deliver the keynote address. Ladies and Gentlemen, I am happy to present to you, the former Vice President of the United States, The Honorable Alben W. Barkley.

MR. BARKLEY: Mr. Chairman, members and guests of the American Institute of Industrial Engineers. I suppose all of you know that I am a pinch hitter today, taking the place of the Congressman from this district, who is not able to be here because of a vote on the St. Lawrence Seaway, yesterday in the House of Representatives. I don't know how you feel about that, but I am glad it passed, and by a very substantial vote.

I did not know till this morning that I was expected to fill in for him, but I am very glad to have the honor of being asked to do it, because I served in the House of Representatives with his father for a number of years, and although he was of one political faith, and I of another, we were always on speaking terms; in fact, we were very warm personal friends, which frequently is true in legislative bodies and in all their relationships. I was very interested in Mr. Parker's experience in Utah, which reminded me a little of a delegation I was on during World War I. Six members of the House of Representatives went to France, as a committee to look into it. I had voted for the declaration of war against Germany, and for the Selective Service Act, and I thought I ought to join the Army; I had young children and I went to see President Wilson about it, told him I had voted for the war and thought I ought to get in the fight. "Well", he said, "We have to have a Congress, and there are only 531 members in the Congress, including both House and Senate, and if all of you resigned and joined the Army, it would not have any appreciable effect on winning the war." But he told me to go see Secretary Baker about it, which I did, and the two of them together persuaded me to remain in Congress and not resign to join the Army.

So, all these years I have held public office a long time, as the Chairman has already indicated, but it looks like my military career has just begun, for I have just been appointed a Kentucky Colonel, and in December the Governor of Tennessee made me a Tennessee Colonel, and it looks like with those two commissions of a Colonel, I ought to rank now as a Brigadier General.

On this trip to Europe, the six of us called on the "Tiger" Clemenzeau, one day. Two of our delegation were from Utah, one of them was a Mormon and the other was not, so while we were in Mr. Clemenzeau's office he asked us where we were from, and when he got to these two men from Utah, he said to one of them, "I suppose you are a Mormon". And he said, "Yes, Your Excellency, I am an Elder in the Church". And Mr. Clemenzeau said, "That's wonderful, I congratulate you", and he turned to the

other gentleman from Utah and said, "Of course, you are a Mormon, too", and the other gentleman from Utah said, "No, Your Excellency, I am a Gentile with Mormon inclinations". This amused Mr. Clemenzeau very much for he understood English very well, in fact had taught school in this country many years before the outbreak of World War I, and in that connection I think of the amusing story of the school teacher, quizzing her young class of boys, and finally she said to them, "Who was the Father of Our Country" and there was a moment of hesitation, then one boy held up his hand and said, "Brigham Young", and the teacher said, "No, Brigham did well, but he is not the father of our whole country".

I want to congratulate this convention on two things: (1) the size of the delegation-the representation, and as Judge Thomas, a Kentucky Judge who died only a year or two ago, used to have a habit of saying, "I congratulate you on the numerosity of your membership", and I also congratulate you from breaking away from Ohio and coming to Kentucky. You are only 5 years old, I believe, and this is your fifth annual convention, four of them you have had in Ohio. Ohio used to be called the Mother of Presidents, took that title away from Virginia, but I know of no real reason why it should be the Mother of Conventions. We all have many friends in Ohio, and it is one of the great states of the Union. I have traveled all over Ohio, in all sorts of transportation facilities, and I think there is no state in the Union that has a better average, a better balance of industry, education and agriculture, cities and towns and all that goes to make up a great state, than has the state of Ohio, that is next to Kentucky, I will rank Ohio, second to Kentucky, my native state. I was very interested in the references to grandfathers, and great grandfathers, for I am both. I am a grandfather and have seven grandchildren, and the other day I was presented with a great-grandchild. I have a grandson, who graduated from Princeton last year with high honors, at the age of 22, and before he had his commencement, they had offered him a position at the University out in Honolulu to teach History and English Literature, and he immediately got married, went out there and accepted the position, and about a month ago he made me a great-grandfather.

Of course, I am not old enough to be a great-grandfather, but the reason I am at this time, I started out early myself. I just lost no time.

Ohio has many advantages over Kentucky, but we have one advantage over every state, people liver longer in Kentucky than they do anywhere else, and they live better. We had a couple here in Kentucky, in Louisville, a couple of weeks ago who got married. The groom was 100 years old and the bride was 69. Some of the members of the girl's family objected, so I understand they had to elope. Now in my end of the state we are noted for longevity, and we had an old fellow down there celebrating his 100th birthday, and everybody was patting him on the back and congratulating him, and finally one neighbor said to him: "Mr. Knight, to what do you attribute your longevity?", and he said, "Well, I never drank, I never smoked, I never overworked, I never overate, and I never underslept", and the neighbor said, "Well, I had an uncle who lived the same way and he died at 80", and the old man said, "Well, he just did not stick to it long enough". So, I will say as the old man said, we stick to it long enough down in my part of the State. We had another old fellow celebrating his 100th anniversary, and he was asked about it, what formula he had for living so long, and this old gentleman was very active, very alert, both physically and mentally, and he said, "Well, before I married my wife and I had an agreement, that after we married, if at any time, I railed out at her, nagged her, or picked a fuss with her, she would just pick up her knitting and go out in the kitchen and knit until it was over, and on the other hand if she picked a fuss with me, or railed out or picked a nagging time with me, I would put on my hat and walk out doors, until it was over, and the reason I have lived so long is because I have spent the most of my life out in the open air".

Today, as you know, I am a substitute for the man, A Republican Gentleman, who was to deliver the key-note speech here today. I have done that many times, under different circumstances, and I am always glad to substitute for those who cannot substitute for themselves. I hope you understand that I am substituting for a Republican, and I have had my arm twisted here in Kentucky, and so I am this year going to be making an effort to do the same thing, and make substitution for another Republican.

Now, as a Private Citizen, a status that I have really enjoyed, as I have been busy, been able to be at home, but I welcome you here to Kentucky as a Private Citizen, glad to do it, and proud to do it, because we are proud of our State. Every person should be proud of their State, and most people are, but there is a peculiar reason why we are proud of Kentucky -- because it was the first state carved out of the wilderness, West of the Allegheny Mountains, during and following the American Revolution.

It was here that George Rogers Clark, a Virginian, organized a little band of 125 to 150 men to cross the Ohio River during the Revolution and rescue what became known as the Northwest Territory (which is now made up of Ohio, Indiana, Illinois, Michigan, Wisconsin and part of Minnesota) and thereby the Mississippi River, the Western Boundary of the new nation, the crest of the Allegheny Mountains, and after the Revolutionary War, Vermont became the 14th state, they beat us into the Union. Kentucky was the 15th and as I said, the first state carved out of the wilderness, West of the Allegheny Mountains. In this state was established the first educational institution for higher learning, which only a week or two ago celebrated its 175th anniversary and was visited by the President of the United States, and inasmuch as I was invited to the celebration of Transylvania's 175th Anniversary, to greet him at the airport, and to sit on the platform with him, I was very happy to accept and I did so, to welcome him to Kentucky. We have many other things besides history and romance (we have a great deal of that). We are famous for three things, fast horses, beautiful women, and what is sometimes described as a good brand of liquid vegetation. Sometimes the enthusiasts get a little too much of the liquid vegetation and gets his tongue and brains twisted and refers to Kentucky as the State of Beautiful Horses and Fast Women, and we resent that - the horses are beautiful, of course, but the main thing they are fast, too, and also our women are beautiful and good, too. We have always been an agricultural state, predominently, producing a great quantity of tobacco, and we have become much more than is realized throughout the country, an important state in the production of livestock.

I think that we produce as fine a quality of livestock, beef cattle, as well as thorobred horses, and the race horses, as can be found anywhere in the universe. We have so many advantages in addition to these, that people are gradually becoming attracted to the State of Kentucky. For a long time there was a dispute about what the word Kentucky meant - the Indian name was Kan-tuck-ee (and for a long time it was described as "The Dark and Bloody Ground".

Then in the last part of the century further research disclosed that the word Kan-tuck-ee instead of meaning in Indian language, "The Dark and Bloody Ground", meant "The Land of Tomorrow", and so we have gotten a new definition, a new meaning of the word from which Kentucky is derived, as The Land of Tomorrow. We think it is a land of tomorrow, because our natural resources have been rightly developed under a program of our government, for flood control for the protection of cities and the farms and the area along the Ohio River, which periodically gathers waters from some ten or twelve states, and brings about wide spread devastation in low points. Under a flood control program, adopted by the Congress of the United States, following the great disastrous flood of 1937, we are being gradually able to protect our river cities from these recurring floods, with the devastation of life and property. We are offering these cities and towns now a more permanent security, and for industries

along this great highway of progress, and also though a program of developing our rivers, which are public property, which Congress has control of, because you can't build a bridge or any other construction across any navigable water in this country without getting the consent of the Federal Government, usually by an Act of Congress, although I think they have authorized what used to be the War Department, the Corps of Engineers, under the Department of Defense, to approve any efforts, any enterprise, for the construction of any sort of construction in the way of a bridge, or any other thing connected with any of our navigable streams, rivers, etc., and we have in recent years developed these natural streams.

Tennessee Valley Authority, with which you are familiar, and also familiar with the amount of controversy regarding it (into which I am not going) has brought about a development in Western Kentucky and Tennessee, Alabama, Georgia and North Carolina, and this has not been paralleled anywhere else in the United States to the same extent. I have myself been enthusiastic about that development - I worked for it for a long time, following World War I, and finally saw it consummated, and I do not believe that any man or woman who ever saw the Tennessee Valley and the people in it, and the conditions in it prior to its development, and who would go there and see now, the new life, the new towns, the new cities, new homes and make a comparison then I don't believe they would want to abolish what has happened, as a result of this development, which has given us one of the largest artificial lakes in the world, 190 miles long, with 2600 miles of shoreland, and we have developed power down there, which was instrumental in bringing to Paducah, my home town, the atomic energy plant, which at its peak, employed 24,000 people. Industries from all over the country have come into our State, and into that section. The same is true of Eastern Kentucky, where Roosevelt Dam and all those projects which have not only brought new life into the community, but have offered those who seek it and desire it, infinite recreation and infinite pleasure and sportsmanship, I would not take away from any State anything that they have, but if there is anybody looking around for a good place to locate an industry, before deciding what to do about it, come and look over Kentucky, and then you will realize not only do we have these natural resources, but that this State is the land of Tomorrow, not The Dark and Bloody Ground. We have a population that is friendly and hospitable and intelligent, so my friends, from these 26 states, I hope you will forgive me, as your key-noter, if I steam off a little bit about the state in which you are meeting, and I am glad you are here and I am glad that your largest meeting in your district has taken place here.

I have heard from casual conversations, that you have enjoyed your visit to Louisville, and while it has no particular development in the artificial sense, like the Tennessee Valley or the Wolf Creek Valley, there has come to the city of Louisville, (The Gateway to the South) a large number of industries, which have added to the value and wealth and employment of the city, and it is a gratifying thing as a Kentuckian, and I am sure the people of Louisville understand that to see this city developing, we have to do our part, it has to do its part, (as well as your part, wherever you come from) to strengthen the economic stability of our country, because in this time of crisis, with all the world standing on tip-toe, wondering what will happen tomorrow, wondering whether the great liberties, the great way of life that we have enjoyed so long, that we have become accustomed to, and rarely realize that there are vast areas of the world, with billions and billions of people who never enjoy the freedom we think so little about, and people are wondering how long, we ourselves, will be permitted to enjoy this way of life which has come to us, and which we have developed because of our character and our resource.

In this field, the field of engineering, no matter what sort of an engineer you may be, whether you play a minor or an indispensable part, you may be astonished, if you don't already know it, that sixty years ago, a prominent American said, "Electricity

may be an interesting fad, but it will never become universally used". Yet these past sixty years, we not only have seen electricity take the place of other forms of power, but we have seen the profession of electrical engineers become so indispensible in industry, in the domestic life of our country, that most of us can hardly realize that there was a time in our society, when there was not electricity, and when the electrical engineers were not part of not only industry, but of our homes, public enterprises, because of the indispensable quality that his work covered.

We have mining engineers who are likewise indispensible in the mineral field, and we have gotten ourselves agricultural engineers, because we know now, after research and further knowledge, we know that there is a need for scientifically trained men, men trained in the science of the soil, just as there is a science of the stars, and so agricultural engineers have become a very indispensible activity for our farmers and those who depend upon agriculture for the things they eat and the things they wear. Soil conservation is a part of it that brings into play the engineers, for a generation ago, we awoke to find one third of our rich soil had washed out into the waters. One-third, and yet we were increasing in population, and each acre of land had to support more people than it did the year before, and it was estimated a few years ago that when the Mississippi River was at high tide in flood, it deposits in the Gulf of Mexico, 40 acres of rich land, every hour, so we found out that we could not go on increasing our population, and depleating our soil, unless we wanted to become like China and India, over-populated and under-productive, so we had to inaugurate the program of soil conservation, which required engineers. Now I am not going to talk about all the kinds of engineers, because you belong to one particular type, that of industrial engineers.

I suppose it is true today that the profession of industrial engineers is not as ancient, not as old, as some of these other branches of engineering, and yet in my technology, in the complexity of our lives, brought about by the genius of our people, which has transformed our methods of life and our patterns of thought in the last half century, the very complexity of our industry and our relationships between employer and employee, the cost and production, the desire to hold down price to the consumer as much as possible because he must pay for what he buys, so long as we do justice to those who produce the products, the men who invest capital, so that they shall not suffer because of the desire to merely cheapen the price paid for their product. It would be a disaster and would weaken our economy, if in the effort to reduce and keep down the cost of production, you took away the profits of industry. It is my understanding that a part of your work, as industrial engineers, is to find a balance between employer and employee to improve and stabilize working conditions, and at the same time see that adequate and fair profits are guaranteed to those who have invested their money in these industries for which you are engineers. Your job is a wonderful thing, for it is not only constructive engineering, but it is also public relations, efficiency experts, know-how knowledge, and all together parts of the profession which is yours, that of industrial engineering.

I congratulate you upon organizing from the national standpoint of your profession. We have become specialized in this country - medicine has become specialized - law has become specialized - you don't see the general practitioner as much as you used to, and you have corporation lawyers, trial lawyers, tax lawyers, etc., and we are even specialized in education, so that those qualified to give student, some special training, so that in this complex day in which we live, socially, politically and industrially, it is essential that there be technicians, who regard their profession so highly, that they live their profession, they are proud of it, they organize themselves and work together for their profession. I am in a mood to congratulate you on seeing the necessity of making your work a real profession, and organizing it as a profession in the field of industrial relations, in the field of stabilizing our

economy, so that we may be strong as a nation, to withstand attacks that are being made upon us, and upon our way of life, and our method of government.

The part that you may play, are playing, and will continue to play in this struggle for the survival of our freedom, the right of a man to work or not to work, to speak or not to speak, the right of newspapers to print the news, the right of people to assemble, the right of an individual to own his home, to educate his children, the right of man to pick his profession, without government interference, or no more than is necessary to protect the weak from the strong, the good from the evil, and regardless of our business, our politics or our religion, our geography, we must all work together to preserve these things that enable you to organize, that enables you to specialize, that enables you to determine what you want to do in life - as Benjamin Franklin said at the convention at which the Declaration of Independence was written, "We must all hang together or we will hang separately".

In this fight for a democratic institution, in this fight to preserve our way of life, we must fight together to ward off this sinister thing that seeks to destroy our freedom which gives us the right to be, if we will, industrial engineers. We must hang together - we will hang together - to avoid the awful pitfall of each one hanging separately.

So as I said, Kentucky is now known as the Land of Tomorrow -- and I think you can look upon yourselves as the Profession of Tomorrow. We know that the world today is short of engineers, that in the engineering schools, every student almost has been employed before he gets his diploma, and therefore there is a great need for more industrial engineers as well as industrial engineering schools. I hope there will be one established in this state in the near future, there certainly is a need for it.

Therefore, as a new organization, new in the sense that you are only five years old as a national organization, though you have been in your profession longer than that, I think I can congratulate you on your growth up to this time, and predict for you in the future, an advance in membership and in service not merely to employees and employers, not merely to industries that locate here and there, but service to our great institutions, to our way of life, to our freedom and by helping to make us strong, to resist this attempt to weaken us and to undermine our faith in our government and in ourselves. Let me thank you at this time for your gracious attention which you have given me, and for the opportunity to say these few words to you. Good luck to all of you. Thank you.

MR. DERRY: Thank you very much, Mr. Barkley. One thing we can do in Kentucky is produce and I think this speech is a good example of how we can produce in Kentucky.

EXHIBIT ROSTER (Industrial Engineering Products)

Vogue Products Co.(*)	Bowman Field	Industrial Pictures
Clayton and Lambert	1707 Dixie Highway	Domestic Hot Water Heaters, Blow Torches
Sou. Chemical Sales	Board of Trade Bldg.	Overhead Doors, "Tornado" Industrial Vacuum Cleaner
J. R. Hahn Co.	1253 So. 3rd Street	Stapling Machine
Mystik Tape Products	1023 South 21st St.	Industrial and Domestic Tapes & Adhesives
Boxer Supply Co.	650 S. Preston St.	Foster Air Hose Fitting, Sheet Metal Shearer "Nibble"

(*) All Louisville, Kentucky

FIFTH ANNUAL A.I.I.E.

CONFERENCE AND CONVENTION COMMITTEES

May 5, 6, 7 and 8, 1954

Louisville, Kentucky

COMMITTEE	NAME	COMPANY
National Conference and Convention Chairman	Stephen A. Derry	The Derry Management Engineers
Conference Program	Robert E. Card(*)	Anderson Woodworking
	Dr. Raymond Villers(*)	(N.Y.) Management Consultant
Host Chapter Chairman	Roy B. Davis(*)	Alemite Co.
Publicity and Promotion	Robert L. McCormick	Tube Turns
	Horace L. Pearce	Reynolds Metals
Arrangements	Sterling H. Durst	Gamble Bros.
	Rocco McGuffin	International Harvester
	Edward A. Vetter	Peerless Manufacturing
	Duane A. Thompson	General Electric
	Kathleen McGuffin	Ladies Auxiliary
Registration	Edward M. Thoben, Jr.	Am. Radiator & Standard Sanitary
Agenda	Robert B. Craig	Porcelain Metals
Reception	Gerald E. Napier	Colgate Palmolive
Industrial Booths	Charles B. Skinner	Tube Turns
Printing and Mailing	John R. Wernert	International Harvester
Proceedings	Thomas C. Potter	Tube Turns
Student Engineering Service	John K. Rigby	E. I. DuPont
Civic	Raymond C. Rickwald	Clayton & Lambert
	John Ulrich	White Industries
	Jack Rouse	Jeffersonville Quartermaster Depot
	James S. Ritchey	H. J. Scheirich
Finance	Veith Herre	Schenley Distillery
Policies	Wm. N. Bryant	American Saw & Tool

(*) Appointed by National Convention Chairman

A.I.I.E. NATIONAL OFFICERS - 1953-1954

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Frank F. Groseclose
Georgia Institute of Technology
Atlanta, Georgia

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U. S. Steel
Pittsburgh, California

Assistant Executive Secretary
Stephen D. Veirs
F. & R. Lazarus Company
Columbus, Ohio

* * * * * *

LADIES PROGRAM

WEDNESDAY, MAY 5, 1954

Bus tour of Louisville. (U. of L. Campus, Speed Museum, Iroquois Park and amphitheater, Gardencourt, and Cave Hill Cemetery. Lunch with A.I.I.E. - Kentucky Hotel. Tour of a Major Distillery. A.I.I.E. Social Hour - Kentucky Hotel. Dinner. Carriage House Players.

THURSDAY, MAY 6, 1954

Tour Stewart's Department Store. Tour of Kurfees Paint Plant and buffet lunch. Visit Churchill Downs. Dinner with A.I.I.E.

FRIDAY, MAY 7, 1954

Tour of Courier-Journal newspaper plant. Participation in radio broadcast, "Coffee Call". Tour of radio and television studios. Watch televising of "Noon Roundup". (News, Music and Weather). Lunch at Kentucky Hotel, and showing of spring hat styles. Demonstration of outdoor cooking. Dinner. Ada Lee's Tap Dancers.

SATURDAY, MAY 8, 1954

Travel to Churchill Downs. Lunch with A.I.I.E. at Churchill Downs. Watch the running of the "Kentucky Oaks".

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(1) Getzow presenting "My Old Kentucky Home Key" to AIIE founder Stanton.
(2) Getzow presenting "My Old Kentucky Home Key" to Prexy-AIIE-Groseclose.
(3) Derry presenting "My Old Kentucky Home Key" to Prexy-elect Malcolm, AIIE Natl. Hdq. Office Manager - Miss Patterson.
(*)(4) Groseclose presenting "My Old Kentucky Home Key" to Honorable W. H. Martin (Assistant Secretary Defense).
(5) Arthur Briese putting over a point in "English"---.
(6) The Famous "VEEP" Kentucky Smile---Senator Alben W. Barkley.
(7) Reg. V.P., AIIE-Reed & Rathe presenting Chapter Charters to Doulet & Gunnis.

(*) No Photograph Available.